AMERICAN MACHINIST

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A Nine-Foot Radial Drill.

In our issue of April 11, we illustrated one of the latest examples of English tool building, being a radial drill press, which, judging from the number and character of the shops in which it has been placed, has met with the general approval of English engineers.

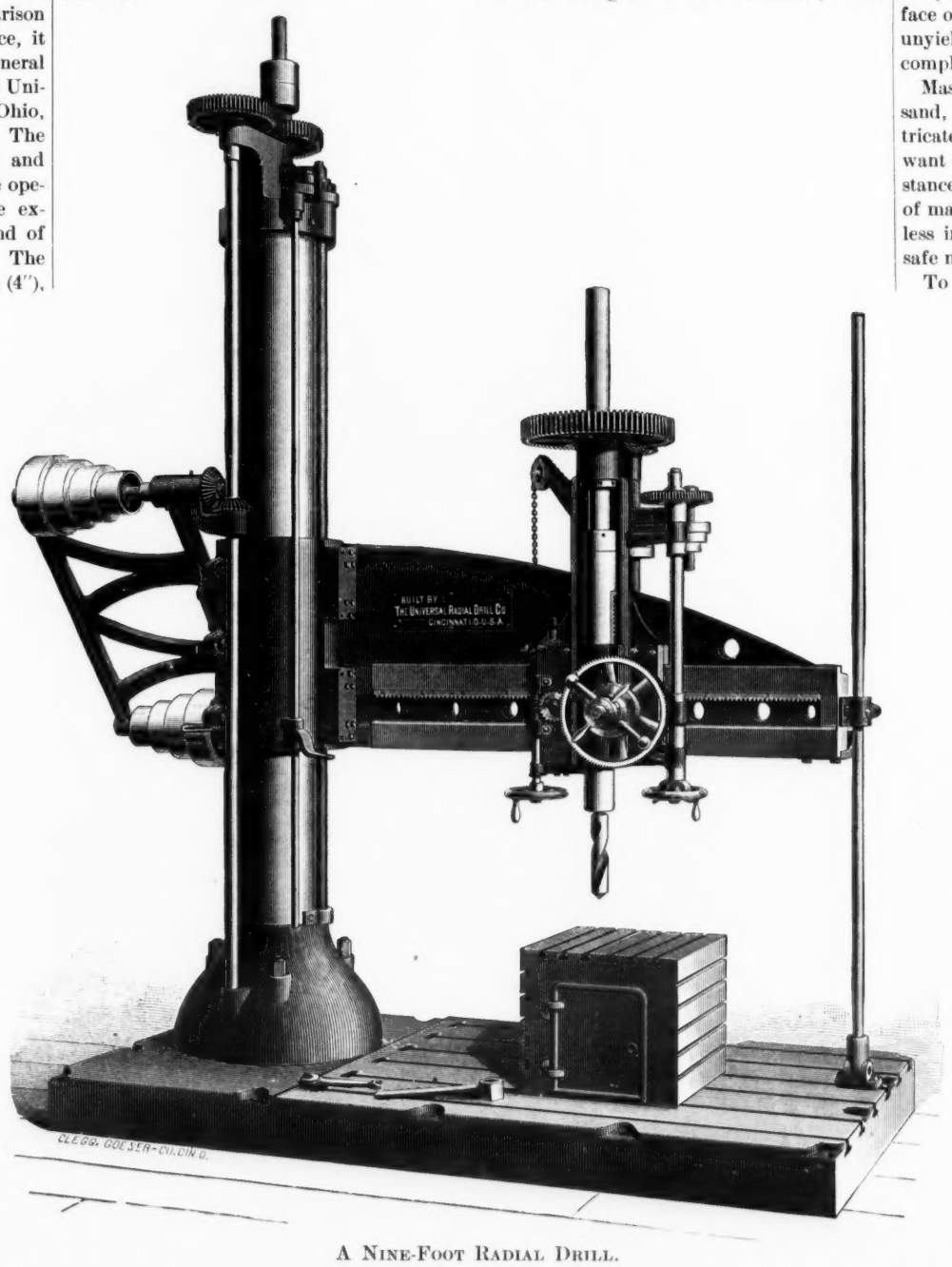
The present illustration will afford our readers on both sides of the water an excellent opportunity for making a comparison between American and English practice, it being a radial drill press of the same general dimensions recently completed by The Universal Radial Drill Co., of Cincinnati, Ohio, for Cramp's shipyard at Philadelphia. The length of the arm is the same (9ft.) and the extreme height of work which can be operated upon is practically the same, the extreme distance from bed-plate to end of spindle in the present case being 9′ 6″. The spindles are the same diameter in each (4″), but the weight of the American press is 12,120 lbs. greater, being 33,000 lbs.

In general design and appearance the two machines are totally different. In the present machine the arm does not swing upon the column, but the column is fitted over a stump which has a sufficient length of bearing to prevent deflection. The column can be made rigid with the bed-plate by tightening the nuts shown at the bottom. The arm is raised and lowered by power, through the medium of the screw and gears shown, the lever for controlling this movement being at the lower end of the sleeve. Power is received from a vertical shaft above the column, which drives, by means of spur gears, the vertical shaft at the side of the column, which in turn drives the upper cone pulley. The lower cone pulley is provided with internal gears which drive positively (without employing friction), yet can be thrown in or out instantly, without stopping the machine. As the motion for raising and lowering the arm is derived from the vertical shaft at the top of the machine, the arm is always moved at the same rate, regardless of the speed at which the spindle may be running.

The lower cone pulley is upon the end of a shaft which passes along the back of the arm, and, by bevel gears, drives a short vertical shaft, which is behind the drill spindle and drives it by means of the spur gears shown. From this short vertical shaft the feed motion is derived, by means of cone pulleys and the worm gearing shown. On the large worm gear is a friction clutch for throwing the feed in or out, the two handles shown being for the manipulation of this clutch, while the two longer ones are for moving the spindle up or down rapidly by hand. The head is moved along the arm by means of a rack and pinion worked by the worm gearing and hand-wheel seen at the left.

At the extreme end of the arm is a clamp, through which passes a tie bar that is attached to the bed-plate by a swivel. This tie bar is readily removable and is intended to be used only when extraordinary rigidity is desired. The height of the column is 13′ 6″, and its diameter 18″; the total height of the machine without the countershaft being 17′ 2″. It will drill to the center of a circle 15′ diameter and has a continuous feed of spindle of 24″. The table is 28″ × 28″, and the bed-plate 6′ × 12′.

Stove manufacturers are counting on a heavy trade this fall, with light summer business.



A NINE-FOOT RADIAL DRILL.

Moulding in Loam, from a Complete Pattern.

BY S. BOLLAND.

It is safe to say that if good loam moulders were as numerous as good green sand moulders, failures would be less frequent; and also that castings of a higher type of finish would adorn our engine rooms and factories, as well as public edifices. There is undoubtedly a limit to the practicability of moulding in green sand, owing to the instability of the materials used, as well as to the inadequacy of such materials to resist the enormous pressures at work in moulds of considerable magnitude; and, consequently, we look in vain for a reproduction, in the casting, of the even surfaces and symmetrical curves of the pattern; for, from the above-stated causes, all evidence of previous design in the pattern is often entirely obliterated. In addition to this may be mentioned the extra labor which such imperfect work entails on the machinist, at the parts which have been prepared for external fittings; also bored surfaces, which suffer on account of the accumulations of dirt and scum, which always form in greater abundance in green sand moulds, than is the case in either dry sand or loam. Examined from this standpoint, it becomes a question whether, in a large majority of cases, the loam casting is not the cheapest, exclusive of the fact of its superiority of finish over the one made in green sand.

Critically speaking, we consider the limit of green sand moulding to be reached when the moulder fails to accurately duplicate the pattern he moulds from. Just how far this limit is exceeded, from mercenary and other motives, may be discovered by a careful survey of our public buildings, where a considerable percentage of cast-iron has entered into their construction. To one acquainted with the tricks of the trade, it is easy to find lifter and tool-marks in abundance; places where scabs and swells have been imperfectly removed with the chisel can be readily traced; mouldings and figures imperfectly finished; in fact, botch jobs in most cases, for the simple reason that the founder had attempted to accomplish on a soft, yielding surface of green sand, that which only a hard, unyielding surface of loam would have accomplished.

Massive castings, which, if made in green sand, would be full of complications, and intricate to mould, and, very often, for the want of ability, unsafe, become in many instances, comparatively simple jobs, and easy of manipulation if made in loam, requiring less intelligence, as a rule, to make both a safe mould and a creditable casting.

To meet these emergencies, dry sand is sometimes resorted to; but this method also has its limits, either because the several parts needed for the construction of the mould cause undue expense, or the casting, if too ponderous, would require flasks too large for safe handling. To obviate this latter difficulty, recourse is frequently had to bedding in the floor, using dry sand materials for its construction, and drying the mould where it is made with improvised ovens or fire pans; but as this is only a makeshift, and not unfrequently a poor one, we shall not dwell upon it.

I am willing to admit that very many of the heavy castings required for mill and forge works, building purposes, and all such as call for strength only, may, with propriety, be made in green sand; but when, along with strength, beauty must be combined, then look about for the best method to meet the dual demand, and, when all the pros and cons have been gone over, I conjecture that a loam mould will be decided upon as the safest and best for the job.

To most moulders the idea of making a piece in loam when the entire pattern is supplied seems ridiculous; but a little consideration of the superior advantages offered by this method will soon dispel this illusion. Again, how often we see castings made on end in loam, at great risk and much additional cost to the founder, simply because, perhaps, one-tenth of the outside mould can be swept by the spindle; when, if a few lags had been attached to the patterns (which must be made in any case), an entire pattern would be obtained from which to mould on its flat, in such position as would best meet the several requirements of the job.

Many founders object to loam work because of their limited oven space, forgetting that increased facility in that particular would enhance their ability to accomplish larger and better work, and thus secure to themselves a more extended patronage. Self-interest ought to suggest the propriety of being able to make the finest castings, and, having once secured that reputation, there need be no fear for their success. Another

objection is that too much floor space is required for its production; this objection can, I think, be easily disposed of, as in most cases jobs which, if made in green sand, would cripple the shop for nine or twelve days, might be built in loam, somewhere aside and convenient to crane and oven, floor space only being required to pit, and cast the mould.

No good green sand moulder need shrink from the task of moulding in loam; for, rest assured, the difficulties are only apparent. It is not by any means hard to make excellent loam moulders out of such as are well skilled in green sand, simply because they have become accustomed to construct moulds out of material far more yielding and flexible than that with which the loam moulder works. There is a decided difference when the opposite task is attempted; the loam moulder soon discovers the lack of rigidity in the sand, compared with the dried loam he has been accustomed to, and invariably retires in disgust.

I will now endeavor to point out the main features in the construction of a first-class loam mould. First, decide at what parts of the pattern the several divisions must be made in order to an easy separation of the walls, due attention at the same time being paid to the closing together of both outside walls and internal cores. Choose the best method of pouring, and arrange for gates in the brick-work or plates, or both if needed. Calculate your ability to transport the parts of the mould, and build accordingly.

In making plates for carrying the several parts, observe the very important rule of having them strong enough, and arrange lugs and lifting staples in such order as will secure an even distribution of the weight. When practicable, have all core irons of sufficient strength to resist upward pressure when secured at the ends. This, of course, necessitates the casting of lugs on all plates at such places as will best meet this requirement. Study to avoid as much as possible the use of studs, exposed naked to the iron, always preferring to make a safe job by some other method, even at the expense of a little extra time; by the exercise of a little ingenuity in this direction, serious flaws in the casting may often be prevented.

The accompanying drawings and views represent the water end of a high-duty pumping engine, such as are made by the firm of Henry R. Worthington. Fig. 1 is a sectional view, and Figs. 2 and 3 are end elevations. The casting weighs from 8 to 10 tons, according to thickness. Castings of this class call for a high degree of finish, inasmuch as they are exposed to view, whilst the steam cylinders are usually covered with ornamental lagging.

A careful study of Fig. 4 will be all that is needed to fully understand the mode of procedure in the early stages of this job. The entire pattern is seen to rest on a bed of loam, spread evenly over a course of bricks (previously laid), immediately underneath it. This course of bricks is set back from the edge of the pattern, to allow loam sufficient with which to form the joint *A* along the bottom flange. Flange *B* and suction chamber *C* are detachable from the body, as are all ribs, brackets, hubs, etc.

The arrangement is to build the bottom half of both ends as permanent structures on the foundation plate, as seen at *D*, Fig. 4, and *A*, Fig. 5, where, in both cases, only a portion is shown as built. The separation is made central with the prints *E*, Fig. 4, and *B*, Fig. 5, the building being continued on the lifting plates *F* and *C*, as shown in the respective figures. Hook bolts, set in the staples shown, serve to bind these walls firmly to the top plates, after the manner seen at *G*, Fig. 4, and *D*, Fig. 5.

A careful examination of the view of pattern will show why the plate *D*, Fig. 5, is set below the top. Provision in this case must be made for a joint round the face of branch *H*, therefore the plate *D* must be set below the flange, and the brickwork continued above in such form as will permit of easy access to the branch when the mould is closed. The method for lifting these ends is clearly shown, and it will be noticed that Fig. 5 is a reversed view of Fig. 4, which allows a full representation of each end in preparation, as well as completed.

Observe that, as the ends are built, the joint against which the sides abut must be formed, strict attention being paid to the necessary taper for easy separation. The sides are shown as built up to the flange in Fig. 5, the method of carrying them being in all respects similar to that shown for the ends. Plate *I*, Fig. 4, rests on a loam bottom against the lower joint *A*; bolts at the staples shown connect with plate *E*, Fig. 5, in which plate handles are cast for lifting, as seen at *A*, Fig. 6. This figure shows the whole arrangement in section.

As seen at *G*, Fig. 5, and *B*, Fig. 2, another joint is here formed, and the building continued up to the top of suction chamber *I*, Fig. 5, and *C*, Fig. 6. Plates such as shown at *F*, Fig. 5, serve to carry this brickwork, and are secured, as before explained, by bolts to the top plate, as shown at Figs. 5 and 6. In order to a quick separation of the parts when all is built, have the plates *F*, Fig. 5, covered with loam, level with the prickers, and dried; the dry loam will absorb enough moisture from the soft loam upon which it is bedded, to admit of almost immediate separation. To form the mould over the suction chamber, lay thin bars across from pier to pier against each course of brick as they are being laid (on soft loam), as seen at *J*, Fig. 5, and *D*, Fig. 6. The top plate at *J*, Fig. 5, is cut midway, to expose this method in section, whilst at Fig. 6 the bar is seen resting on the piers.

Fig. 5

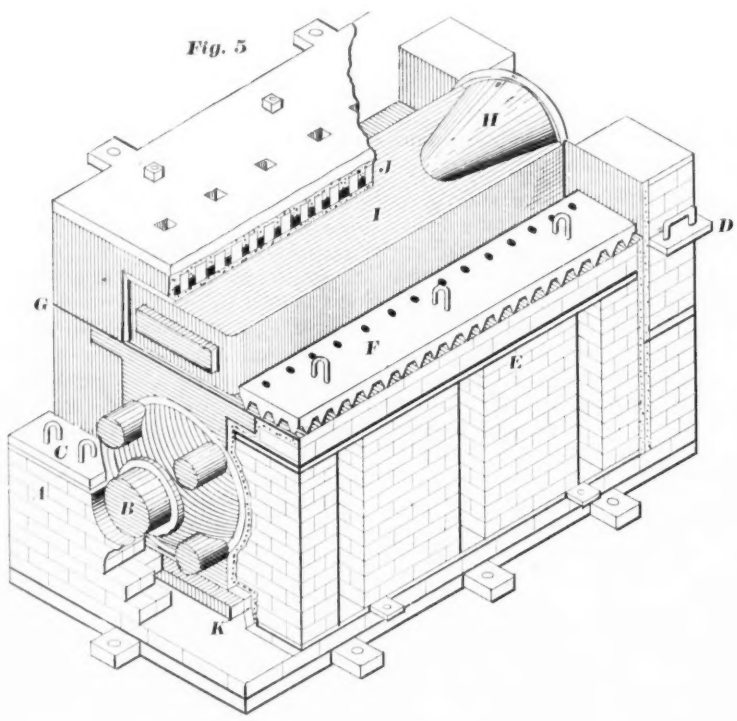


Fig. 6

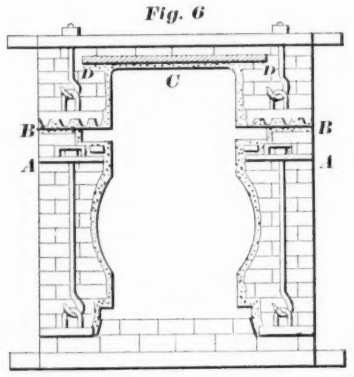


Fig. 2

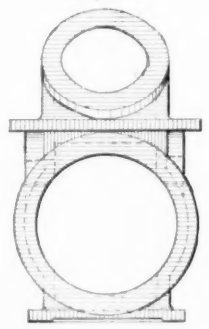


Fig. 1

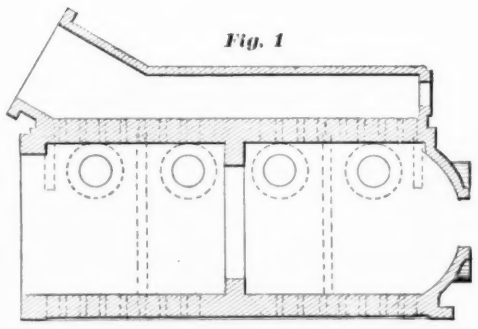


Fig. 3

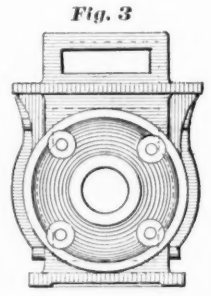
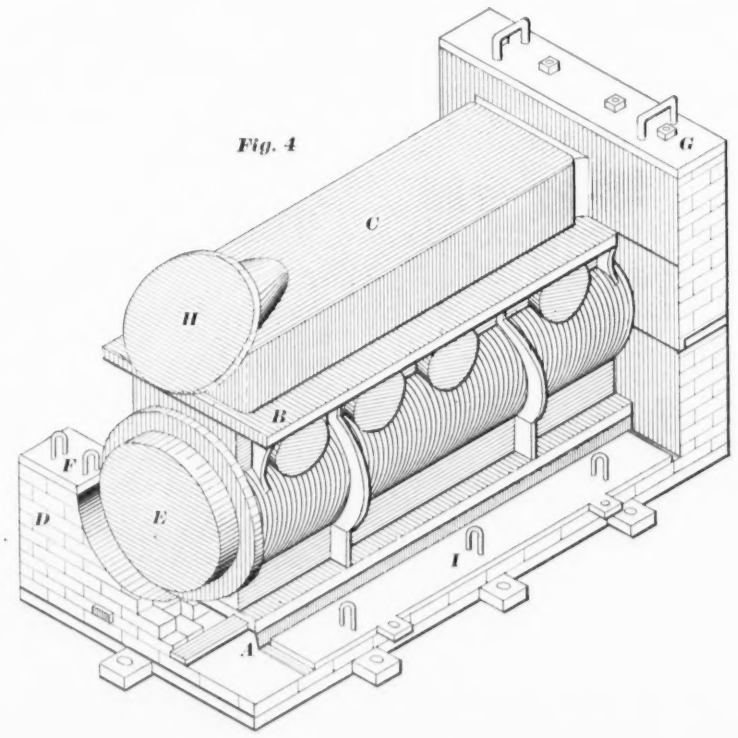


Fig. 4



Enough of detail is shown in these illustrations to give a clear understanding of the whole process of moulding such a casting in loam, and renders any further explanation superfluous. As before stated, all the parts being detachable, such as would interfere with an easy separation of the mould are, of course, to be loosened and allowed to come away with the cheeks.

After marking all the joints, the ends are lifted away, then the top separates at *B*, Fig. 6, after which, flange *B*, Fig. 4, is lifted out, the sides taken away and the pattern withdrawn. The portion of flange which extends past the end at *K*, Fig. 5, is made loose, built in the end and drawn out after the pattern has been lifted out.

The lugs shown on the ends of the foundation plate can be utilized for bolting down the body core, and should it be thought necessary to hold down the middle, have holes in the core iron to correspond with other holes in the foundation plate, directly in line with the center of one or more of the valve cores, through which a bolt or bolts can be passed and thus secured.

These instructions are given, not only to show how to make this particular casting, but also to lead the minds of the uninitiated in the direction for grasping the underlying principles which govern the art of loam moulding, which, if rightly understood, as exhibited in this example, their application to other classes of work becomes easy; for, with very slight modifications of the methods herein displayed, almost every emergency may be successfully met.

The *Mining Journal*, of London, utters a wail two and a half columns in length, about the unreasonable efforts of the English miners to secure an advance in wages, and says:

"No thought of the vital circumstances connected with the matter is taken by the miners in their consideration of the subject of a rise in wages. Indeed, it is doubtful whether they think upon the matter at all beyond the probability of their receiving a few more shillings every week."

We should infer from this that it might be the custom in England for people having anything to sell, to consider all sorts of things besides what they can probably obtain for it. But knowing that human nature in England is much the same as here, we think probably that people there who have anything to sell consider mainly the question of what they can get for it, whether it be labor or something else which they are trying to find a market for. That is the method pursued in this country by those who have anything to sell.

It is quite refreshing to read of the result of a contest between Standard Oil and the people of Toledo, in which the former came out second best. The company had secured a franchise for piping the streets of the city for natural gas, and was charging exorbitant prices for it. The complaints of the citizens being of no avail, they appealed to the State Legislature for permission to issue bonds for the construction of a pipe line of their own, and though the Standard fought the measure in the Legislature and at the municipal election, it was carried, and the people's line will be laid. Now if Toledo can so levy the taxation for the payment of these bonds as to make the burden fall upon those who really receive the benefit of cheaper gas, and in proportion as they receive the benefit, she will have done a good thing all round.

American millers, who have only one kind of wheat to grind the year round, and those devotees of single wheat milling who would let the baker do the blending, will be inter-

ested to know that it is not an uncommon thing in English mills for millers to grind a mixture of six different kinds of wheat. At this moment a miller of our acquaintance, says the *Miller's Gazette*, is grinding a mixture of Californian, Hungarian, Russian Azima, Dede Agatch, Kurrachee, and English, divided into eighteen parts, and is getting a yield of 71 per cent. on the uncleaned wheat. —*The Engineer* (London).

The Sukkur bridge, the opening of which we announced in our last issue, has cost 400,000 rupees less than the estimate, and been completed six months sooner than had been anticipated. These results show in a striking manner the advantage of the cantilever system.—*Engineering*.

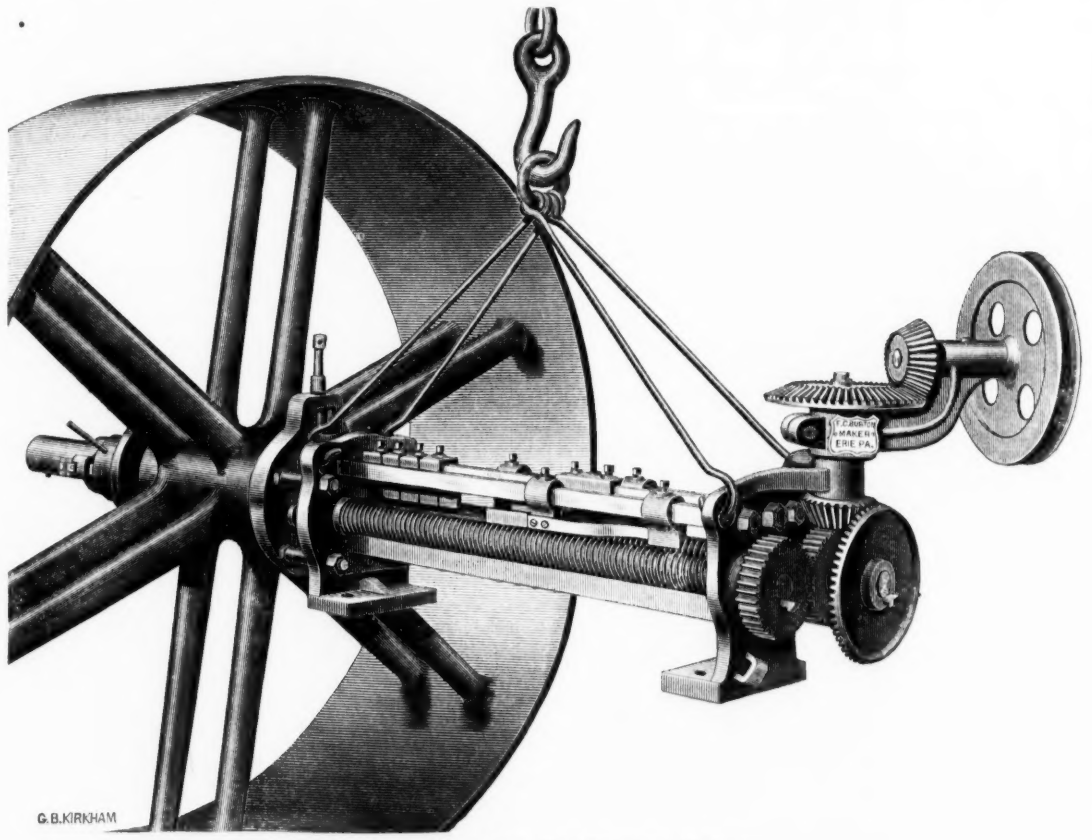
The Erie Portable Key-Seating Machine.

This machine is designed to meet all the requirements of a machine shop in the matter of internal key-seating, the range of the standard machine being from $2\frac{7}{16}$ to 12-inch bores, all widths desired from $\frac{1}{4}$ up to $2\frac{1}{2}$ inch. Any length up to 24 inches. To accomplish this there are two arbors and cutter bars. The smallest is $2\frac{7}{16}$ inches in diameter, and is supplied with eccentric taper bushes to accommodate it to all bores up to $4\frac{7}{16}$ inches. The arbor is hollow, and has within it a bar called the guide bar, which is movable up and down by means of a screw at each end. It is planed out through its entire length the necessary size and shape to carry within it a tool bar, which carries two tools of the width desired for the key seat. It is connected to the driving carriage by means of a removable pin, and is driven back and forth through the guide bar, cutting in both directions, being fed down to the desired depths and taper by the screws at each end.

The second arbor is $4\frac{7}{16}$ inches in diameter, and is constructed the same as the other, but in place of using the taper bushes to bring it in position in the bore, the arbor head or flange is made a three-jawed chuck, and indexed to suit different bores, so the jaws can be adjusted as desired. For the other end of the hub a movable chuck is supplied, and indexed in a similar way.

Both the arbors are supplied with a clamping device, which clamps the work firmly and quickly in place. On each side of the arbor are cut a series of ratchet teeth. A collar with loose ratchet pieces is slipped on the arbor, the pieces dropping into the teeth. By pushing the collar against the hub and turning a nut, the work is held firmly in position. It will be seen by the foregoing description that the bore is the guide by which the machine is set, therefore no facing of hub is required.

The driving apparatus consists of two parallel screws $2\frac{1}{2}$ inches in diameter, $1\frac{1}{2}$ inch pitch, triple-threaded. They are set 6 inches from center to center and run in opposite directions; between them is an open-sided nut, which slides from one to the other within a carriage. The nut engages in one screw and travels the desired distance, when it comes in contact with a cam which throws it out of gear, and by a spring it is pushed in gear with the other screw. The nut has on its top two ribs, one of which, by passing behind a guide, holds the nut in gear; the other serves to receive the pressure of the spring. By shifting the cams, springs and guide, any desired length of stroke can be made. The traveling of the nut carries with it the carriage to which the cutting bar is attached. The screws are driven by cut gears running smoothly, and giving a very strong motion to the cutter bar. The machine can be used in several ways: as a portable, being carried to the work by crane or overhead tramway; or set on a truck constructed to raise or lower it; or set on a bench or feet, and the work lifted to it by hand or by small crane and chain hoist. By the use of a third arbor, seats can be cut in bores as small as $1\frac{3}{16}$ inch by one passage of the cutter. Made by F. C. Burton & Co., Erie, Pa.



THE ERIE PORTABLE KEY-SEATING MACHINE.

Improvements in Boiler Making in England.

BY W. H. BOOTH.

There was a time when anything would do for a boiler, and no place was too bad in which to work it.

Those days are gone by, but in England, at any rate, all improvements have sprung from the owners of boilers, the steam users, who banded themselves together as an association for the preventing of boiler explosions. This was the first attempt at regular periodic boiler inspection ever made, and though the parent of all boiler inspections and insurance companies, has never at any time on its books many more than 4,000 boilers, yet it has been the means of setting many other companies going, so that I can count up some 72,000 boilers under inspection by the companies I can bring to mind as I write. Their influence has been so great that the whole public mind has been elevated on the question, and some firms are so particular that the floor of the boiler-house, *i. e.*, above the side flues and between the boiler crowns will be carpeted, all which has a good effect from the moral influence exerted. Very little of the improvement has come directly from the boiler makers; it is principally the users, backed out by a very small number of makers, that the making of boilers has attained so high a place as a mechanical art in England, but more especially in Lancashire. Of course the steam users, in banding together, have been guided and advised by engineers, and it is remarkable that more improvements have sprung from engineers than from boiler makers, and that many of the best inspectors of boilers are engineering rather than boiler making specialists.

The chief influence of the various inspection societies has been exercised chiefly through the calling for tenders for construction to certain standard drawings and requirements and the carrying out of the same under inspection. For some time the best class of work was not possible, the hydraulic riveters on the plate edge planer were not in every boiler maker's hands, and it has taken years to overcome prejudice, and even to prove that certain methods of construction were better than the older fashions. The barbarous plan of bending plates after piercing took a lot of killing, and it took a deal of persuasion to abolish the everlasting standard 2" pitch for everything. Only by dint of perseverance have boiler makers as a class been taught that it is possible to make tight work in pitches greater than $2\frac{1}{2}$", and there are still makers who will caulk a boiler on the water-side, though years ago we found out the practice was liable to lead to grooving.

The whole subject of staying had to be reorganized and based upon the movements of boilers when at work, and not upon their behavior under a cold hydraulic test.

That man of whom Mr. Redfield writes, in the AMERICAN MACHINIST of April 4th, has my respects for what he does to prevent air flowing largely into the furnace when the door is open. The opening of the furnace door should almost stop the draft, except under special circumstances. An inrush of cold air through the open door often sets up immense stresses, causing wear and—literally often—*tear*. If engineers and boiler makers would pay a little attention to the man on the firing floor they would learn much of use to them. As a class, boiler makers seem to have but one idea—to increase heating surface, increase numbers of tubes already too numerous, without any care whatever as to how they do so.

Nickel Mining.

The nickel industry of the world is a most peculiar one. It has only been about sixty years since it first came into use as a mineral, though it has been known to Japan and the eastern nations for centuries. There are nickel mines in France, Germany and Wales, in Pennsylvania, Nevada and Oregon. Nickel is not, as is generally supposed, a mineral that is mined like silver and then smelted and reduced from an ore. It is a chemical element which is extracted from arsenides, cobalt, and sulphides. The yield from these substances, as found in France and Wales, is only about 2 per cent. nickel, but the yield of some mines in Nevada, not yet developed, is fully 20 per cent. of pure nickel.

About thirty years ago there was discovered in New Caledonia—a French penal colony—a wonderfully rich deposit of nickel. A French company was immediately formed, and this company to-day almost controls the trade in this country. It also almost controls the nickel trade of the world, and it has frequently declared its intention to ruin every other nickel manufacturer and run them perpetually out of the business.—*The Colliery Engineer*.

Warner Miller said at the dinner of the Spanish-American Commercial Union, the other night, speaking of this country: "We must make less or sell more." While not literally true, what he said is undoubtedly a near enough expression for the very general feeling that there is needed a larger outlet for manufactured goods. Mr. Miller named what he thinks is a solution of the problem, viz., the graning of subsidies to steamship lines. Undoubtedly this is a matter that will bear discussion. Direct intercourse with South America, for example, is one of the needs of this country; but it would be much more satisfactory if steamship communication could stand on a solid basis, instead of asking help from the Government. Still, there is abundant precedent for subsidies in the instance of the English Government, which deals very generously with steamship lines under the cover of compensation for carrying the mails, and the fact that steamships flying the British flag reach every country where there is prospect of trade, gives British manufacturers an immense advantage. The constant tendency in this country is to increase manufacture faster than the limited market warrants; hence there is every few years a sitting down, as it were, and waiting for increased population to strengthen the market. But in view of the rapid development of the manufacturing interests of the country, and especially in view of the building up of manufacture in a part of the country that formerly paid almost literally no attention to it, this cannot go on much longer. An outlet for manufactured goods has come to be a necessity; the only question, and one not easily settled, is, how shall this be had?

A good story is told about one of the Maine Central engineers, says the *Bangor Commercial*. Last summer, when the Vanderbilt car was at Bar Harbor, the manager of the Maine Central sent an engine down there to take the car to Portland. The run was made in very quick time, and at Brunswick the train stopped to take on water. While there Mr. Vanderbilt got out and said to the engineer that he didn't want him to drive so fast. The engineer, the veteran Simpson, looked at him for a quarter of a minute, and then said: "I am running this train under orders from Payson Tucker to be in Portland at 1.07. If you want to stop here, all right. If you want to go to Portland, get in." He got in.

One advantage of living in a small country like England is that one standard time serves for the whole country, namely that of Greenwich. English time is therefore fixed by that of a point east of which very little of England extends, for the bulk of the British Isles lie to the west of Greenwich. In Ireland the standard time is that of Dublin, which is twenty-five minutes later than Greenwich, but Ireland is separated by sea from England, and no inconvenience results from the difference of time.

What the every-day machinist or draftsman doesn't know about electricity would usually make a pretty good sized book; and what is more, he knows it. A private letter from a friend, who manipulates a T-square for a well-known firm of tool builders, closes with the following information: "I have got a new office—Electrician for the ——— Co. I go around and fill up the batteries of the telephone transmitters, and when they don't work, wonder what ails 'em."

Steam-Driven Centrifugal Pump.

The illustration given herewith shows a new style of centrifugal steam pump lately placed on the market by the Morris Machine Works, of Baldwinsville, N. Y. The engine is of the throttling type, and is directly connected to pump, its shaft being also the pump shaft. The pump, being of large diameter, can for a moderate lift be run at a very low rate of speed. It combines two features which are especially novel: the suction is placed between the pump-shell and engine, and can be placed at any angle by loosening a few screws. The scroll can also be changed to meet any situation by a similar operation, while by removing the plate, as shown in cut, the interior of pump can be examined without breaking a joint in either suction or discharge pipe. This style of pump, by reason of the extremely low rate of speed required, and its compactness, is particularly well adapted to use in connection with surface condensers on shipboard for circulating purposes.

The Milling Machine and Its Operations.

By A. B. Landis.

No. 5.

In my last article I gave my method of straight-line dividing on the Universal milling machine, for cutting racks, etc. As most milling machines do not have any attachment for cutting racks, I herewith illustrate one which I made for use on the No. 3 Brown & Sharpe machine. Upon inquiry I found Brown & Sharpe did not make any attachment for this size machine, and, as I needed one, I designed the one here shown. It will be seen that all the gearing is entirely cased up, fully protected from any cuttings, and no danger of getting the fingers hurt.

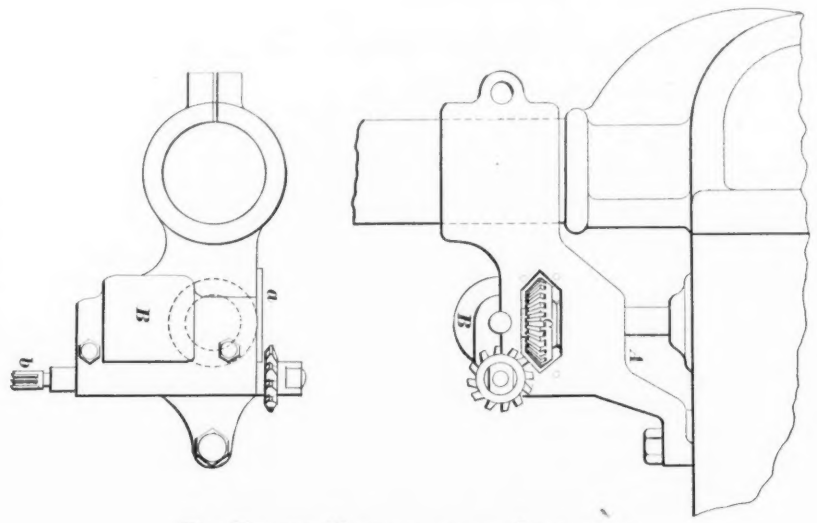
The casting is bored to fit the supporting arm, and split through at the top; a lug provides a means for a bolt to clamp it rigidly. The lower end is bolted to the body of the machine, which makes it a very firm attachment.

To get the arbor hole in correct alignment with the spindle, I had the surface *A* dressed off smoothly and true; then with a pointed piece of steel held in a short arbor I scribed a circle by revolving the arbor; then I chucked it in a lathe, and trued it carefully by the circle described.

Bevel gear *c* gears into a similar wheel, which has a long hub, upon which is slipped and secured a steel sleeve, which has a face 2½ inches in width with 12 pitch teeth cut upon it, which mesh into teeth cut upon the cutter arbor. It will be noticed that a very small cutter can be used. A cap *B* is bolted over the wheels, and also forms one-half of the bearings of the shafts. The opposite end of the cutter arbor can be drilled with taper hole to fit the small end mills used on the machine, and can be used to good advantage for milling work on the dividing head, and thus avoid the trouble of arranging the dividing head to face the spindle of the machine; a cap or plate *a* covers the bevel gear shown, and is held in place by small screws.

For the tool-room, this device (or any other that answers the purpose) will be found of great value, as there is where the tool repairs are expected to be supplied from; and how often do we have to make repairs on racks on machines in the shop that are too long to be cut on this machine in the ordinary way. The inserting of teeth is not a sure and reliable one. The great convenience afforded with this attachment, and the quick time it can be done in, will always make it pay to replace the racks with new ones, and they can then be made of steel, which will in all probability avert any future replacing or trouble.

As there are a great many No. 3 Brown & Sharpe Universal milling machines in use, there are no doubt some who could use this attachment to great advantage. And as it is the intention that these contributions shall be for the benefit of at least some of the readers of these columns, I here state that I can be of further benefit to such who would want to make and apply the device shown, by supplying them with the castings for the same, together with a blue-print drawing of it, at a nominal figure, if they wish it, thus enabling them to apply the attachment at much less cost than by making a pattern. But it is free for the use of any one, in whatever way he chooses to come about it.



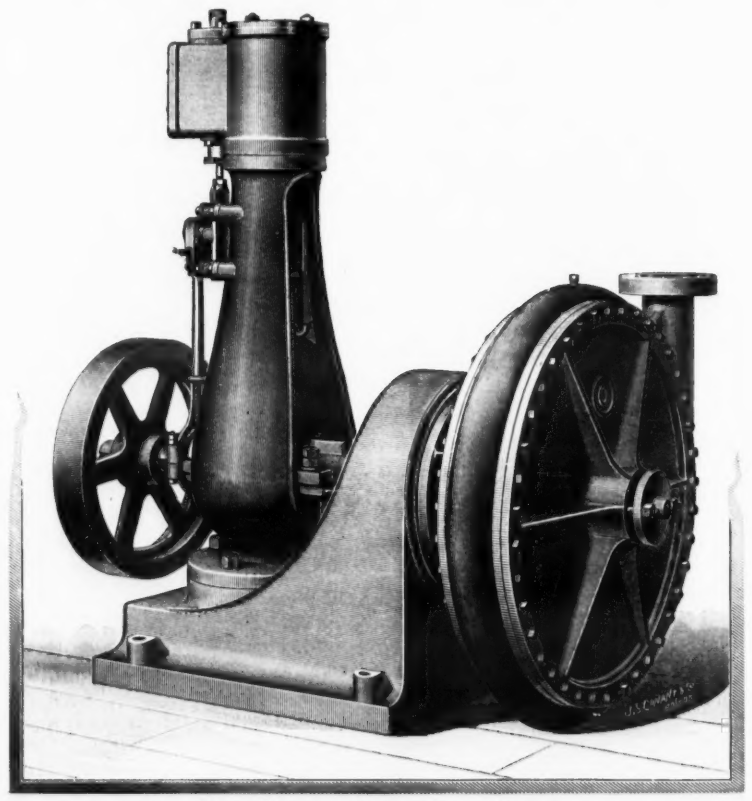
The Milling Machine and its Operations.

Shop Notes.

At Hartford, Conn , The Billings Spencer Co. are, as usual, well supplied with orders, and have recently increased the number of drop hammers to forty. The rapidly increasing use of electricity is shown by the fact that the business of making drop-forged copper commutator bars for dynamos has increased until between five and six tons of pure copper are used for this purpose per month. Recently a few bars have been made from Tobin Bronze, the idea being to obtain greater durability, if possible, without sacrificing too much conducting power. For electro-motors, where the commutator is exposed to dust and grit of various kinds, there is rapid wear of the bars, which it is desired to avoid if possible. Besides the copper mentioned, there is now consumed twenty-five to thirty tons of iron and steel per month, about three-fourths of it being steel. Picking up a newspaper item relating to the spinning rings used in cotton mills, Mr. Billings said it was now no uncommon thing to receive an order for 100,000 of them, and that since he had been in the business he had made 4,000,000. Before he began drop-forging them they were welded up from a bar. Among the latest jobs undertaken is a crank-handle, used by E. P. Bullard at his Bridgeport Machine Tool Works. This handle is of the usual balanced type, having a ball at the end opposite the handle, but instead of being made in two pieces, as is the usual practice, it is in one piece of wrought-iron, the handle being first forged and finished straight with the body of the crank, after which it is bent at a right angle. It makes a very neat handle, and one which is agreeable to the hand. It seems, too, as though it could be produced at less expense than the handles made in two parts, except, possibly, where the body is made of cast-iron, as is sometimes done. The shops have recently been equipped with an electric lighting plant, both arc and incandescent systems being used.

At The Pratt & Whitney Co. shops, changes are constantly going on; and the building which was put up across the street for a warehouse is now very largely appropriated for shop purposes. Part of this is due to the work being done upon machine guns, of which they are building a large number, of various sizes, for the U. S. Government, most of them being destined for use upon the new war vessels. The plant of machinery for making these guns is very attractive to the eye of a mechanic, and splendid work is being done upon them. All of this machinery is, of course, the product of the works, and much of it has been specially designed for doing the work upon these guns.

A model pattern shop has been fitted up in the same building, and power is now furnished by a "Straight Line" engine, steam being carried from the original plant of boilers, about 450 feet distant. No engine could possibly run more quietly or in a more satisfactory manner.



Steam-Driven Centrifugal Pump.

The tap and die department of the works is of especial interest to a mechanic, Mr. Woodbridge, who has charge of this department, having many interesting things to show.

The screw cutting dies made here have been cited as perhaps the best example of the modern art of making interchangeable parts of machinery and tools. Four cutters are set into a collar, the inner ends of these cutters having the threads cut upon them, and the outer ends beveled to fit beveled slots cut in a ring, which fits over the outside of the collar, and by means of which the cutters may be adjusted to size. The cutters are numbered from 1 to 4, and any one of them may be ordered by number at any time, in case one should break; and it will not only fit into its place in the collar, but the threads will exactly match with those on the other three cutters, and the die will be as good as before. This result is accomplished primarily by having sets of standard pieces, with which others being made are compared, and brought into conformity. Care is taken to have the four slots in the collars, into which the cutters fit, exactly equi-distant from each other, in conformity to a master collar, which is kept to try new cutters in. The master ring which fits over the outside of this master collar, and, by the beveled slot upon its inside surface, forces the cutters into their places, has upon its upper edge some projecting pieces of steel which come into contact with the face of the collar, and prevent the ring from going down onto the collar further than to make their faces just even. When the master cutters are in place, and the ring is slipped down until these pieces come in contact, the standard screw thread plug gauge, the threads of which are ground and lapped exactly to standard size, will just fit into the threads of the cutters. Now, if one of these master cutters be taken out, and another one, which it is desired to test, put in its place, it can be determined whether it is the right length or not by the fit of the plug gauge when the ring is down in its place; though, if the cutter be too long, the ring will not go down. In this way exact uniformity of length of the cutters is maintained. But what seems the most difficult thing is the exact matching of the threads; or, in other words, to make them so that the threads on each of the four cutters which go to make up a die shall vary from each other in distance from the working, or lower edge of the cutter, by an amount just equal to one-fourth of the pitch, so that they shall follow each other in a true spiral, and to be able to make them in large lots independently of each other, so that when any four of them are taken indiscriminately and put together to make a die, the threads shall exactly match. The cutters are first milled to proper size, and then the threads are cut on them one at a time, in a special machine which somewhat resembles a lathe, but has, in place of the ordinary carriage, a special one, to which the cutter is clamped with what is to be its lower edge when in the die placed against a solid shoulder upon the block to which it is clamped. A hob is held on the centers by which the threads are cut, and the carriage is fed by a device similar to that used upon the Fox lathe, a threaded sleeve of comparatively large diameter being placed beyond the driving pulley upon an extension of the main spindle. Connection is made between this threaded sleeve and the carriage by a chasing bar, connected or disconnected at will by a lever. Upon one end of the threaded sleeve is a tongue, which fits into any one of four equi-distant radial slots, which are cut in the side face of a collar, which is made fast to the spindle, and by this means the threaded sleeve is driven. The four slots in this driving collar are numbered to correspond to the numbers of the slots and cutters in the dies, and, the vise on the carriage, in which the blanks are clamped, being adjusted to bring any one number of cutters right, it is only necessary to slip the tongue on the threaded sleeve out of the slot in the collar and into the next one, to bring the position of the vise just right for the next number of cutters; for, by doing this, the threaded sleeve is turned on the spindle just one-

fourth of a revolution. The shoulder, against which the blank cutters are clamped, is adjustable to a slight extent upon the carriage to bring it right in the first place, and when new hobs are put into use. To know when it is properly adjusted, a cutter is put in and the threads partly cut, when, by a special device, their distance from the lower, or working edge, is compared with one of the master cutters of corresponding number. This comparison is the germ of the whole matter, and is made by the aid of an instrument which seems simple enough. It consists of a horizontal plate, having pivoted upon its upper surface a small lever or pointer, the short arm of which is about one-tenth the length of the long arm. The extremity of the short arm is formed into a sphere small enough to go in between the threads of a cutter. The extremity of the long arm moves over a graduated arc, which is upon the plate. At one side of the sphere, which is upon the short arm, is fixed a piece of steel, so as to form a square shoulder, against which the lower edge of the cutter to be tested is placed.

When it is desired to test one of them, a master cutter of corresponding number is placed against the shoulder, and shoved forward until the spherical short end of the lever enters between the threads, and the graduation at which the long end of the lever stands is noted. Then the cutter to be tested is placed in the same position, and if there is any variation in the position of the pointer over the graduation, the actual error of the threads in the cutter is one-tenth of that variation, and the shoulder on the carriage is adjusted until the error is eliminated. Of course this is a mere outline of the more important features of the process, there being numerous details which it would be impossible to describe within reasonable limits, yet which are of course of prime importance to the success of the work. The whole affair is as remarkable and as admirable for the simplicity of the means used, as for the excellent results obtained.

In doing the lathe work upon the regular lines of work in this department, Mr. Woodbridge uses his patent lathe tools exclusively, and some questions addressed to one of the men, who was turning up taps with one of them, revealed an astonishing degree of endurance possessed by the tools. One of them, which seemed to be working as well as though it had just come from the grindstone, had been working in that way without grinding nearly twenty hours, and it was asserted that they often ran longer than that. It is true, the speed of the work was not as great as is often seen, but it was probably fast enough to secure the maximum results, and at any rate, it is safe to say that few, if any other tools made in the ordinary manner, would run more than half as long at the same speed.

In milling the sides of the blades for cutting-off tools, they use a "Lincoln pattern" milling machine, and upon the chuck are fixed short steel studs, which come in contact with the edges of the piece being milled, to hold it in place, while to hold it down there are two rollers, one in front of and the other behind the cutter. These rollers are pressed down by powerful springs, and are mounted in a casting which is attached to an arm passing over the arbor. The rollers are placed as close to the cutter as possible, and, Mr. Woodbridge states, give better satisfaction in milling such work than any other method of holding it.

Brass is used quite generally for slide valves in English locomotive practice, though almost unknown in this country for that purpose. An English engineer, in a recent discussion upon the subject of slide valve friction, said that he had diminished it very much by drilling two rows of holes down the sides of the valves and filling them with pure block tin—the most curious feature of the case being that, as the temperature of the steam used was about the fusing point of the tin, it soon ran out of the holes, leaving them open; the valves, which had not worked satisfactorily before the tin was put in, continuing to work with entire satisfaction after it had been put in and had run out. From this it would have been supposed that the simple drilling of the holes would be sufficient without the tin, but experience contradicted this, and indicated that the tin before disappearing performed an important service (perhaps in modifying the surfaces), and prevented cutting.

On one road cast-iron valves had been used,

ADJUSTABLE BLOCKING.

and the wear compared with valves made of brass, and it was found that the wear of the brass ones was about three times that of iron, and that the friction was much greater.

Machinists' Adjustable Blocking.

In a former issue we illustrated an adjustable clamping block, made by the Energy Manufacturing Co., Philadelphia, Pa. We illustrate with this an improved form of the block, the improvement consisting principally in the addition of a set screw and jam nut to the top for adjusting it to the exact height for supporting work. There is also a threaded hole at the bottom, by means of which the block may be held in its place upon the bed of a machine or the face plate of a lathe by a bolt put through from the back. They are made in five sizes, for a total range of height from 2½" to 21".

Note on the Use of Crude Petroleum as Fuel for Raising Steam at the South Chicago Works.

BY E. C. POTTER, CHICAGO, ILL.

(READ BEFORE THE AMERICAN INSTITUTE OF MINING ENGINEERS.)

Fuel oil was first substituted for coal at these works in September, 1888. It was first applied in the converting department to the battery of boilers, consisting of 14 tubular boilers, 16 feet in length by 5 feet in diameter. To operate these boilers with coal for 24 hours required 14 stokers, 3 ash-wheelers, 6 men unloading coal, and 2 water-tenders, making a total of 25 men. With fuel oil the same boilers require for the same period 2 water-tenders and 4 men to attend to the burners, making a total of 6 men. This gives a saving of 19 men, which, at an average of $2 per day each, amounts to $38 per day. Comparing the consumption of oil with that of coal, we find that, for the week ending January 5, 1889, with an ingot output of 6,403 tons, 2,731 barrels of fuel oil were used, as against a necessary consumption of coal for the same work of 848 tons, showing 3.22 barrels of fuel oil to be equivalent to one ton of Indiana block coal. Figuring oil at 60 cents per barrel, and coal at $2 15 per ton, we have as the cost of oil $1.93, as against $2.15 for its equivalent in coal, making a net saving of 22 cents per ton of product.

In December, 1888, the rail mill battery of 26 boilers, of the same dimensions as those in the converting department, was equipped for fuel oil. For the week ending January 5, 1889, with a rail output of 5,208 tons, 5,987 barrels of oil were consumed, as against a necessary consumption of coal, to do the same work, of 1,805 tons, showing 3.31 barrels of fuel oil to be equivalent to one ton of Indiana block coal, which, at the costs named above, would show $1.98 worth of fuel oil to be equal to $2.15 worth of coal. The labor required to operate the rail mill boilers for 24 hours, with coal as fuel, is: 26 stokers, 4 water-tenders, 6 ash-wheelers, 12 men unloading coal; total, 48 men. With oil as fuel, the same work requires 4 water-tenders and 6 men to attend to the burners; total, 10 men; a saving over coal of 38 men in 24 hours, which, at an average price of $2 per day, would be $76 per day.

In the brief experience we have had with oil as fuel, we find that the efficiency of the boilers is somewhat increased and the repairs are materially lessened. The perfect cleanliness of the fuel, and the ease and simplicity of supply and regulation, together with the steadiness and uniformity of steam supply, make it, for our business at least, a most desirable substitute for coal. We have made no evaporation tests of any kind; the only test of its efficiency being the fact of its keeping our works running to their fullest capacity. This we find it will do; and this cannot be said to be true of coal, with our present boiler capacity.

A Method of Splitting Large Pulleys.

BY GEO. O. VAIR.

Large pulleys, 12 feet and upward in diameter, are usually cast whole, and, after being cast, are split in halves, for the convenience of handling and shipping. There are several methods of splitting such castings; also, the results are different. I have seen moulders work on a pulley mould for a number of days, and then lose the casting, caused by the splitting core blowing or breaking in the rim while the mould was being cast. This was simply because there was no practical way of securing and venting it.

The plan herewith shown I consider an expeditious and reliable one to overcome the above mentioned difficulties, for the reason that it admits of retaining and venting the splitting core better than by any other means I have ever practiced. The lugs or flanges for bolting the casting together are formed in a core-box with a pattern, with core print between them to receive the splitting core which is shown in Fig. 3.

Fig. 4 is a top view of the same core. This splitting core extends part way into the rim of pulley, in the form of a V, as shown by dotted lines at *A* in Fig. 2, thereby facilitating the breaking of the rim.

Fig. 1 is a cross-section, representing the lugs, also the splitting and round cores set to place and ready for use. These cores are dried separately and afterwards put together.

First put in splitting core to place, the vent from which is taken through lug core at *B B*, Fig. 2, and then insert round cores for bolt holes. The section representing pulley rim is shown straight, but the lug cores can be as readily made to conform to any shaped rim.

In moulding pulleys to be split in this manner, while the mould is in course of construction there are rammed up two prints diametrically opposite, to receive the lug cores.

In splitting the hubs of such pulleys as we have here under consideration, instead of using cores separate from center core to accomplish the splitting of hub, I approve of such a core as shown in section at Fig. 5, and in top view at Fig. 6. It will be seen that it consists of a round chambered core with wings that extend far enough into the hub to admit of its being easily split, and so as not to retard the flow of the iron while being cast, and also to relieve the thin parts of the core from strain; holes are left in the wings as at *C*. As the different cores in the accompanying illustration are all designated by name, further description is not necessary.

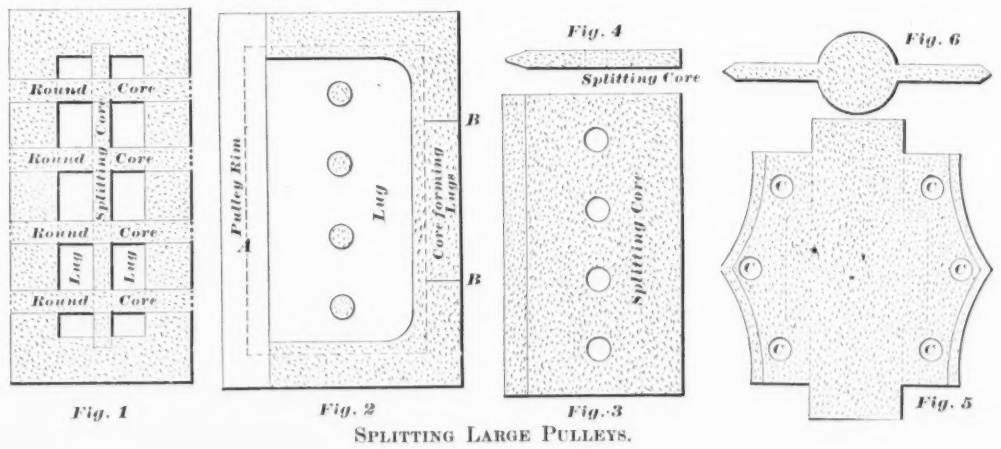


Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6.

SPLITTING LARGE PULLEYS.

LETTERS FROM PRACTICAL MEN.

Three or Four Flutes.

Editor American Machinist:

In your issue of April 4th, in the Question and Answer column (Question 150), W. B. asks: "If two taps of the same size (diameter) are cut, one with four grooves, the other with three, will one cut larger than the other?" An experience of fifty-three years as a machinist and pattern maker has presented opportunities of observing such little matters, and I will give it. A three-fluted cutter tap or reamer will often cut a more or less three-sided hole, a four-sided one will do the same; hence, a plug of what is supposed to be the correct size will not fit the same in all the holes reamed or all bolts in the holes tapped.

I have never known such a thing to occur with a five-fluted cutter reamer or tap. I have found it necessary, particularly in small reamers and taps, to have an odd number of cutters, and even in large ones, where the cutters are let in, to have five, seven, nine, etc., cutters, in order to get a round, true hole. T. M.

Dayton, Ohio.

Wax Corners for Patterns.

Editor American Machinist:

I suppose I have placed myself in a position where it is necessary to explain more definitely why I object to the use of wax for filling corners on patterns; for, if I may judge by the remarks of Frank Richards, in your April 18th issue, said corners "would not otherwise be filled." I was not aware that my last communication suggested corners would be unfilled unless there was wax to do it with, and I agree with Mr. Richards that the filling of sharp corners should be insisted on, for it not only adds to the strength of the casting, but to the looks as well.

My reason for objecting to wax for fillets is, it is not serviceable, is costly in the long run, and does not look well on a light varnish pattern. Let me illustrate: You finish a pattern with wax corners very nicely in light varnish; it goes to the foundry, down goes the vent wire and scoops off an inch or more of wax; for if there is any wax to be found

on a pattern, the vent wire will find it. Of course, the moulder brings it to the pattern shop himself, after having mended the ruptured mould (lost time Nos. 1 and 2), and waits while the pattern maker refills it (lost time Nos. 3 and 4). He can't wait to have it varnished, and very likely before he gets done with the pattern two or three other places will have been visited with the vent wire. The moulder will "sing" a little, gather up the pieces—all sand—stick them on with his thumb, and let it go (lost time No. 5, not counting mended moulds). The same thing occurs to some extent every time it is used, and finally, when it gets too bad, it will be again brought to the pattern maker for repairs (lost time No. 6), and when he is done with it, it will be a fine-looking job, and a costly one, not taking into consideration the bad-looking castings caused by the ruptures; and all this is but the beginning of the end.

Why not fill all corners where needed with metal fillet? This can be got any size, is a good shape, quickly put on, and economical, because durable. Like Mr. Richards, I am not interested in the manufacture of fillet, but I know what the metal fillet is, and the benefit of using it, and always keep a supply of it in the shop.

I do not know as wax has anything to do with black varnish; but if any one will take the trouble to examine, they will find as a rule twice as much wax on a black varnished pattern as on the light one, and it isn't put on for the fun of the thing, either. C. R.

Drawings for Pattern Makers.

Editor American Machinist:

Upon reading the article by B. Crank, in American Machinist of March 21, on drawing-room economy, I am convinced, by the remarks made pertaining to drawings for pattern makers, that he does not fully understand that branch of the subject.

B. Crank states that, to use machine shop detail drawings in the pattern shop, he knows from experience not to be good economy. That is a fact, but the drawings advocated, even if accompanied by a card of instructions, I am positive will be of no advantage. He further states that, "If the pattern maker be given a one-quarter or a one-half size drawing, the first thing he will do is to plane off a board and make a full-size drawing for himself before he is ready to begin actual work upon the pattern." This is true; the pattern maker who endeavors to turn out his work satisfactorily and with dispatch, when he is the recipient of a machine shop drawing, or even that drawing which needs a card of instructions to explain, be it one quarter, one-half or full-size, to work from, will, if the magnitude of the work should warrant such a proceeding, make a drawing for himself; and his reasons for so doing I will try to point out.

It seems to be generally understood that there is a deficiency in the drawings usually furnished the pattern maker. This deficiency a machine shop detail drawing, or a pattern shop drawing with a card, would not supply; nor do drawings of that class furnish what B. Crank terms the keynote of an article by "Tau," in which the latter states that "The office of the drawing-room is to make clear to the hands the necessary information to construct the machinery built by the shop."

The keynote, or, I should perhaps more properly say the note that produced the discord, of the article referred to by B. Crank, where he describes pattern shop drawings, is in the accompaniment produced by the instructions on "that card." The card reads, "Work to figures in all cases." That is good, beyond dispute; yet I think it would be more proper to say right on the drawing: "Do not scale the drawing where figures are given."

The next instruction on card reads, "Make allowance of stock for finishing in the machine shop." This is where the subject commences to get out of tune. Let us assume that the foreman pattern maker allows for finish an amount of stock on patterns which he, in his judgment, thinks proper. When the castings are operated upon in the machine shop, the foreman machinist thinks he can get along with less, and the proprietor grumbles about the extra weight of the castings. Then the pattern maker, in his efforts to please, reduces the stock originally allowed for finish, and the final is, that when the next batch of castings reach the machine shop, they will not finish according to plans. Now, who is to blame?

Right here I will take the position that, if a special drawing for the pattern maker is made, the proper amount to allow for finish should be determined in the drawing room, and if the draftsman or designer has not had the necessary shop experience to decide upon the matter for himself, he should consult the foreman machinist, and whatever amount they determine to allow should be added to the finished dimensions, and the drawing for the pattern maker be made to show the object as much larger as it has been decided upon to allow for finish.

Further, the instruction card reads, "Make your own allowance for draft and shrinkage." From such adscititious effulgence, which so conspicuously elucidates that the pattern must be made to conform with certain established rules, one would suppose that it would cause the sluggish senses of the pattern maker to perceive that his awkward efforts at making a drawing is a waste of time. The truth of the assertion that, when "The pattern maker makes a drawing he is doing that which could be done better and more properly in the drafting-room," I will admit, but that the drawings, together with the card of instructions suggested by B. Crank, would in all cases restrain him from so doing any more than ordinary machine shop drawings, I, for one, do not believe.

Let it be required to make a pattern for a locomotive cylinder or any pattern that involves core work of a complicated nature. A full-size drawing as made by the pattern maker, that is, adding stock wherever required for finish, and shrinkage to dimensions furnished, according to the requirements of the metal of which the castings are to be made, is a primary necessity, providing he wishes to make the patterns accurately. The difference between the drawings of B. Crank and those of the pattern maker is obvious, from the fact that the drawings of the latter embrace that quantity upon which the instruction card and drawings of the former is so explicit, and yet so peculiarly deficient.

The advantages that are obtained by the pattern maker in working from a drawing of his own can hardly be estimated, and can only be appreciated by those who are familiar with the craft. Such a drawing will, in all probability, embody some particular form of construction with regard to the grain of wood, if that material is used. The component parts in the structure of the pattern, so as to obtain the desired form or profile of the whole, and to secure the necessary strength to withstand subsequent abuse, are often shown on his crude drawing, and are qualities which neither the machine shop drawing, nor those usually furnished, could possibly supply. Should templates be required, as is often the case when operating upon curved or irregular surfaces, or in the execution of intricate core work, they can be made direct from the pattern maker's drawing; and the pattern, while in course of construction, may frequently be placed on top of the same, and the accuracy of its dimensions be thus verified.

The drawings usually furnished the pattern maker, including those of B. Crank, do not meet the above conditions, nor do they by any means reach the "keynote;" in my opinion such drawings fall a long way short. The actual requirements of a pattern shop drawing, I do not hesitate to say, will, in the majority of cases, be found such that, unless the draftsman is competent to make a drawing that will show how the pattern must be built, the draftsman had better give the pattern maker a regular machine shop drawing, and leave it to the latter's judgment whether or not he should make a drawing for himself. If it should be desired to make special plans for the pattern shop, make them so as to reach the highest possible point of usefulness. Let the plans represent the casting as you would have it appear in the rough. If a hole is to be drilled, do not show it on the drawing; if a slot or a groove is to be planed out of the solid, omit them; if a cylinder, or something that must be bored out or turned to a finish, make the drawing to show it, and give the dimensions in the rough. Make the drawing, as far as practicable, pattern size, and bestow as much care in its execution as you would on those for the machine shop; they are equally as valuable. Place an index letter and number adjacent to each piece shown, and let the pattern be known by the same. To destroy the pattern shop drawing, or to take care of it only until the pattern is found to be correct, is not serving the best interests of the employer; the pattern cannot last forever, and parts may be lost in going the rounds of the foundry, or it may warp out of shape. It may then be convenient to refer to the drawing and restore the pattern to its original condition; besides, it is inconsistent with the progress of our time to suppose that the pattern, upon giving temporary satisfaction, will also answer all future requirements. Any changes that may be desired can be pointed out on the drawing to better advantage than on the pattern, particularly so if the pattern is pretty well done up by foundry usage. The index letter and figure should also appear on the machine shop drawing, and be placed on the pattern, so as to show on the casting. This will assist the machinist when assembling the machine. The castings can be ordered by the letter and figure on pattern, and as the pattern by this means will be readily identified by the moulder, a voluminous description of the same is not required.

Wm. Hultgran, *Draftsman.*
Ellithorpe Air-Brake Co., Chicago.

Fig. 1

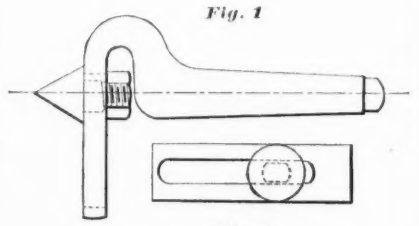
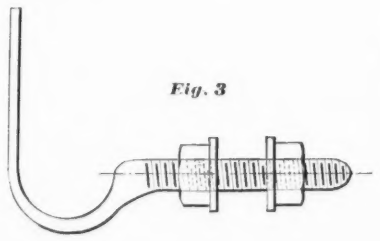


Fig. 2

Fig. 3



Some Lathe Fixtures.

Editor American Machinist:

Having occasion to visit an establishment in which there was no lathe with taper attachment, I saw in use a device that appeared worthy of notice. Thinking some of the fraternity might unfortunately be similarly situated, I give it as it appeared.

Besides having the usual lathe centers always in line, it is quicker and easier adjusted than by using the adjusting screws or tail stock; it can be graduated so the exact amount it is "set over" may be known, and will "set over" further than an ordinary lathe, thus allowing a greater angle to be cut. It is shown by Figs. 1 and 2.

It seems unnecessary to say that it requires to be placed in the spindle *level* with the shears. The usual 60° center is shown; but for all work in which the centers are not in line with the shears, ball-pointed centers are unquestionably preferable.

The other device (Fig. 3) is no doubt familiar to some mechanics, and, were its utility better known, would be used where its place is legated to strings, belt lacings, etc.—a dog or carrier spring for holding work up to the live center while operating on the end of work in steady rest not using tail center.

The threaded portion passes through appropriate holes in face plate, with nuts on both sides, firmly holding it in place, and causing sufficient tension on portion in contact with dog to overcome any tendency to draw away from center. These will be found cheap, safe, reliable, and, in a word, satisfactory. W. E. W.

Copper Boxes.

Editor American Machinist:

In 1883, at the fair in Boston, was exhibited a specimen of copper claimed to have been hardened, and it was claimed that it was a superior article for journal boxes, requiring less oil, and that if it ran dry it would not cut like ordinary boxes. Inquiring of a number of parties that were using it, the information was elicited that the claims set forth were sound, and the writer tried a pair for back end of connecting rod on crosshead. This box has always worked very nicely, being far superior to the ordinary brass boxes.

As to the claims of hardness I am not so sure. The copper cuts quite readily, although it has apparently been treated so that, in filing it, it files more like iron, not clogging a file like ordinary copper.

This was claimed as the invention of a woman, but it was never advertised very extensively, and I think it must have been abandoned.

As is well known, in the manufacture of seamless tubes the tubes are drawn on an arbor through a die. This sets the tube on the arbor very tight, and unless thoroughly lubricated it will stick and cling like a hot journal. Brass tubes in particular give trouble as described, while pure copper tubes never do. Apparently there are lubricating properties in copper that are destroyed when alloyed with spelter, and this may account in part for the general unreliability of brass boxes; it is probable that an ordinary copper box would be more satisfactory than one of brass.

If there be a way of treating copper by chemicals, as the hardened copper was treated, and not be made too expensive, simply to treat so it can be more readily worked, copper boxes might come into general use. They would be cheaper than bronze or the better class of babbitt, when the latter has to be bored. Of course they would not be as cheap as brass or lining metal made mostly of lead.

W. E. Crane.

Practical Drawing.

By J. G. A. Meyer.

SEVENTY-SIXTH PAPER.

Problem 83e Continued.

557. In our last paper we have shown how to lay out the plate for a dome placed on one side of a boiler. It is now required to lay out the boiler plate on which the dome is to be placed. This plate is to have a flange extending into the dome in a manner similar to that shown in Fig. 447 (seventy-first paper).

For the purpose of laying out this plate, we again need two preliminary views, such as are shown in Figs. 465 and 465*a* (page 7). According to the conditions given in this problem, the outer diameter of the shell is to be $40\frac{1}{2}$ inches; and its thickness, $\frac{5}{16}$ of an inch. In Fig. 465, the arc $a\ b\ c$ represents the center of the thickness of the metal, hence the radius with which this arc must be described will be $20\frac{1}{4} - \frac{5}{32} = 20\frac{8}{32}$ inches. Again, in Fig. 465*a* the semi-circle $d\ 4d\ 7d$ represents the thickness of the flange, and since, according to the conditions given, the inner diameter of the dome is to be $19\frac{3}{8}$ inches, it follows that the radius with which the arc $d\ 4d\ 7d$ must be described will be $9\frac{11}{16} - \frac{5}{32} = 9\frac{17}{32}$ inches. Now in order to draw these two views we proceed as follows:

Fig. 465*a*; draw the horizontal line $b_2\ d$, and from any y_2 on this line as a center, and with a radius of $9\frac{17}{32}$ inches, describe the arc $d\ 4d\ 7d$. The lines $b_2\ a_2$ and $b_2\ b_2$ need not to be drawn; our purpose of showing them here is simply to enable us to show the direction of the curvature, which may make the problem to appear plainer to some of our readers. Through the point y_2 draw a vertical line $y_2\ y$; this line represents the center line of dome.

Fig. 465; at any convenient distance above the arc $d\ 4d\ 7d$ draw the horizontal line $b\ o_2$, cutting $y\ y_2$ at the point y_2. On the line $b\ o_2$ lay off a point x; the distance between

this point x and y_2 must be equal to 7 inches, which is the given distance from the center of the boiler to the center of the dome. From x as a center, and with a radius of $20\frac{3}{32}$ inches, describe the arc $a\ b\ c$, cutting the line $b\ o_2$ in the point b. Through the points d and $7d$, Fig. 465a, that is, the points in which the arc $d\ 4d\ 7d$ meets the horizontal line $b_3\ d$, draw the vertical lines $d\ a$ and $7d\ 7a$, meeting the arc $a\ b\ c$ in the points a and $7a$. The arc $a\ 7a$ simply represents the extent of the flange on the shell of the boiler; the depth of the flange, or, in other words, the amount of projection of the flange into the dome, is not shown, as this is not necessary for the purpose of laying out the sheet. Divide the arc $a\ 7a$ into any number of equal parts, say six, and through the points of division $2a$, $3a$, etc., draw vertical lines, cutting the arc $d\ 4d\ 7d$ in the points $2d$, $3d$, etc., and meeting the line $b_3\ d$ in the points $2e$, $3e$, etc. This completes the preliminary views. In laying out a plate of this kind, our first step will be to draw on the plate the outlines to which it must be trimmed off, or, in other words, we must mark on the plate its proper length and breadth.

The methods for finding the length and breadth of a plate which is to form a cylinder, or a portion of it, have been given in our previous problems; the method given in Art. 554 is applicable to the case before us; and an explanation of this method is not needed here. We have therefore broken off a portion of the development in Fig. 466, and shall assume that the lines to which the plate is to be cut have been drawn correctly on it, and shall simply confine our attention to method for finding the position and shape of the hole to be cut through the plate before it is bent and flanged. If now the center of the dome is to be placed $26\frac{1}{2}$ inches from the end of the boiler, as shown in Fig. 447, we must draw the center line $r\ f$ (Fig. 466) at a distance of $26\frac{1}{2}$ inches from, and parallel to the edge $k\ m$, and meeting the line $i\ k$ in the point r. The line $i\ k$ represents the center of the lap, and is represented in Fig. 465 by the point b. In Fig. 465 we also notice that the flange which is to project into the dome extends to the point $7a$. Our next step will be to find a corresponding point $7h$ in Fig. 466. This point is found by making the distance $r\ 7h$ equal to the arc $b\ 7a$, and this is best accomplished by dividing the arc $b\ 7a$ into any number of equal spaces, say eight, and then lay off on the line $r\ f$ from the point r the same number and size of spaces, and thus obtain the point $7h$. Again, from the point $7h$ lay off towards the right on the line $r\ f$ six equal spaces, $7h\ 6f$, $6f\ 5f$, $5f\ 4f$, etc.; these spaces must be equal to those laid off on the arc $a\ 7a$ in Fig. 465. Through the points of division $6f$, $5f$, etc., draw lines perpendicular to $r\ f$. Make $6f\ 6h$ equal to $6e\ 6d$; $5f\ 5h$ equal to $5e\ 5d$; $4f\ 4h$ equal $4e\ 4d$, and so on in succession. In a similar way we make $6f\ 6p$ equal $6e\ 6d$; $5f\ 5p$ equal to $5e\ 5d$, and so on. Through the points $h, 2h, 3h, \ldots 7h, 6p, 5p, \ldots$ draw a curve, and thus complete the outline of the shaded part, which is a portion of the development of boiler plate without any allowance for lap and the flange. The allowance $n\ i\ o\ k$ for lap, and the allowance for the flange, which is the portion of the plate lying between the curve $h\ 4h\ 7h\ 4p$, and the curve $g\ 4g\ 7g\ 4s$, are made as explained in Art. 554. Cut out the plate to the inner curve $g\ 4g\ 7g\ 4s$. The flange must be turned up to the other curve.

Directions.—On a 20″x15″ sheet of drawing paper find the development of a plate for a dome placed 7 inches to one side of the axis of the boiler; the shortest height of dome is to be 18 inches; outside diameter of dome, 20 inches; outside diameter of shell, $40\frac{1}{2}$ inches; thickness of metal, $\frac{5}{16}$ inch. Use 3-inch scale.

558. So far the junctions between the flanges and the straight surfaces have been arcs described with very short radii, and therefore we made no allowance for these arcs, and proceeded as if the junctions had been angular. But in practice we often meet with cases in which the junctions between the flanges and the straight surfaces are arcs of considerable magnitude, and must not be neglected in laying out a plate. A back head for a locomotive boiler is a good example. Fig. 469 represents the appearance of a head of this kind with its flanges turned to the dimensions given, and Fig. 468 represents a section of the same; in fact, these two views constitute a working drawing of this head, and we require no others for laying out the plate. Examining the section Fig. 468, we may conclude that this head consists of three parts, namely, the straight or plane surface extending from the bottom k up to the point e_3; the flange extending from b_3 to h_3; and the surface represented by the arc $b_3\ e_3$, which is the junction between the straight surface $k\ e_3$ and the flange $b_3\ h_3$; the point y_2 is the center from which the arc has been described. To find the exact location of the point e_3 we have only to draw through the center y_2 a line $y_2\ e_3$ perpendicular to $k\ e_3$; the point e_3 in which these two lines intersect is the point required. In a similar way we find the point b_3, that is, we draw through the center y_2 a line $y_2\ b_3$ perpendicular to the flange $b_3\ h_3$; the point of intersection b_3 is the point required. It may be well to remark here that the point e_3 is simply the point of tangency of the arc $b_3\ e_3$ and the straight line $e_3\ k$, and in finding the location of this point e_3 we have simply followed the geometrical principles given in Problem 15, thirteenth paper; the same remarks apply to the point b_3. In this particular example the direction of the flange is perpendicular to the surface $e_3\ k$, and therefore the line $y_2\ e_3$ and $y_2\ b_3$ will also be perpendicular to each other; the arc will subtend an angle of 90 degrees, and the perpendicular distance from the point e_3 to the line $b_3\ h_3$ will be 4 inches. Lastly, the junction $e_3\ b_3$ is of the same form along the sides of the head, consequently in Fig. 469 the straight surface will extend to the broken lines $p_1\ d_2\ e_2\ f_2\ k_2$ which for drawing the lines $p\ d\ e\ f\ k$, as we believe the illustrations plainly indicate them.

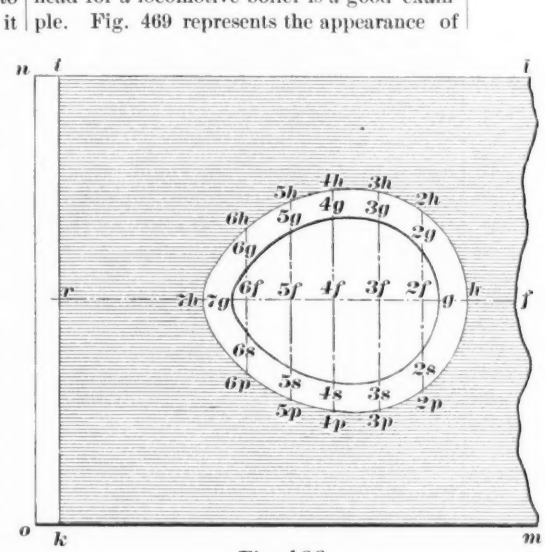


Fig. 466

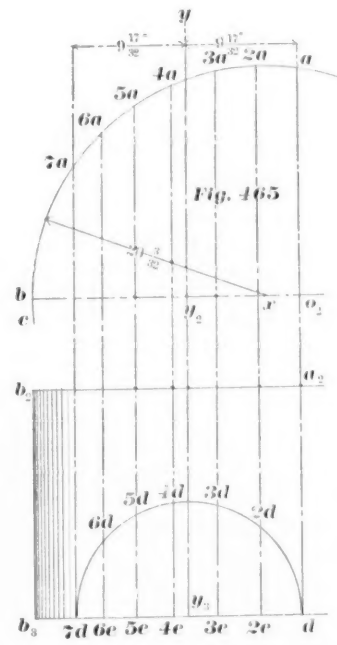


Fig. 465

Fig. 465a

Our next step will be to find the length of the arc $b_2\ e_2$ (Fig. 470). This arc has been described with a radius of $3\frac{3}{4}$ inches, and since it subtends an angle of 90 degrees, it must be equal to one-fourth of the circumference of a circle $7\frac{1}{2}$ inches diameter. This circumference is equal to $7\frac{1}{2} \times 3.1416 = 23.56 +$ inches, consequently the length of the arc will be equal to $\frac{23.56}{4} = 5.89$ inches, say $5\frac{7}{8}$ inches. Outside of the lines $p\ d\ e\ f\ k$, and at a distance of $5\frac{7}{8}$ inches from these, draw the lines $r\ a\ b\ c\ m$; these latter lines represent the extent of the junction between the straight surface and the flange. Lastly, add the width of the flange; this width is to be $2\frac{1}{2}$ inches. Hence outside of the lines $r\ a\ b\ c\ m$, and at a distance of $2\frac{1}{2}$ inches from these lines, drawn the outline $s\ g\ h\ i\ o$. Cut the plate to the latter lines.

In this construction nothing has been allowed for inaccuracies of flanging; the proper allowance for these inaccuracies must be determined by experience.

It may be well to remark that the line joining the centers x and t_2 contains the points of tangency, or, in other words, it contains the points f, e, i, in which the arcs described from the centers x and t_2 meet each other; also the line drawn through the center t_2 perpendicular to $j\ k$ will limit the length of the straight lines drawn through the points k, m, o.

Directions.—On a 20″ x 15″ sheet of drawing paper find the development of the back head for locomotive boiler, whose dimensions are given in Figs. 469, 468. Use $1\frac{1}{2}$ inch scale.

Rapid Work.

As indicating the speed with which work is being executed at Messrs. J. Richardson and Sons' Marine Engine Works, Hartlepool, we may notice the following: The steamship Khio was launched from the shipbuilding yard of Messrs. E. Withy & Co., on Friday last, at 5 P. M., and went into the Victoria Dock that evening to receive her engines. She was taken in hand by Messrs. Richardson's staff, and although no work was done on Saturday afternoon, nor on Sunday, her machinery was tested under steam to the satisfaction of Lloyd's inspector on Thursday at 11 A. M. The total time occupied was thus only $3\frac{3}{4}$ days—a remarkable result, considering the size of the engines, and one which speaks well of the facilities for dispatch at Messrs. Richardson's works. The Khio is fitted with triple-expansion engines on three cranks, the cylinders being 22 inches, 37 inches, and 61 inches in diameter respectively, with a stroke of 3 ft. 3 in. She has two large boilers designed to work at 160 lbs. per square inch. A further instance of quick dispatch is that of a double-throw built steel crankshaft for the steamship Lemura, of 150 nominal horsepower. The order for this shaft was received on Saturday morning, and although no work was done on Saturday afternoon nor on Sunday, the shaft was forged from the ingot, finished complete with keyways cut, and sent off on Thursday forenoon.—*Engineering.*

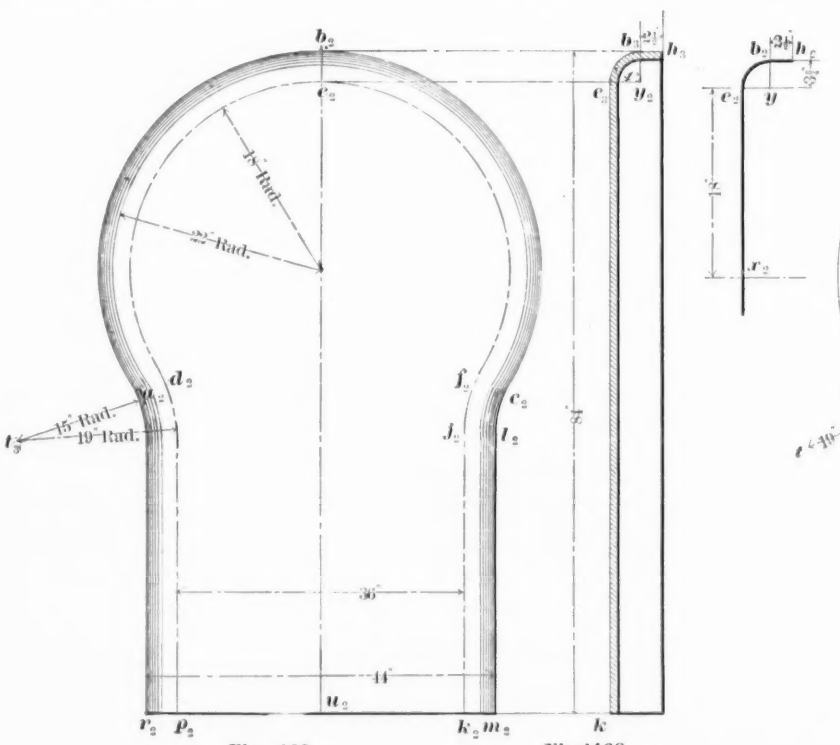


Fig. 469

Fig. 468

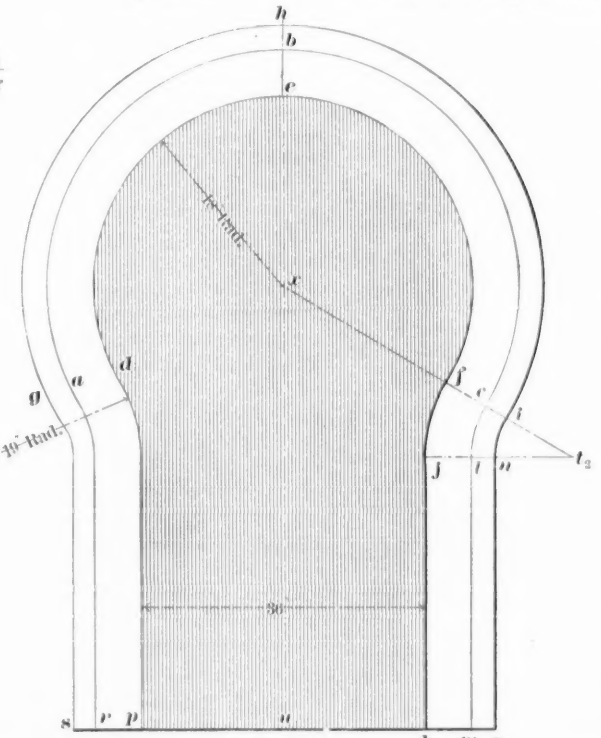


Fig. 470

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NEW YORK, MAY 9, 1889.

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"Patent Applied For."

A decision was rendered in the United States District Court at Detroit, recently, which is of considerable importance to inventors and others interested in patent rights. It seems that an improved burner for gasoline stoves had been invented by a man named Straight, who, having applied for a patent upon it, began manufacturing the burner, and, as is the usual practice in such cases, marked it with the words "Patent applied for."

The burner was improved upon by others, who immediately began manufacturing it, using, however, some of the features upon which Straight had applied for a patent. Thereupon, Straight sued for an injunction, claiming that the words "Patent applied for" protected him from infringement.

The court held that the device is no protection, and that the injunction could not therefore be granted.

The reasons given were that the court could not assume that the patent would be issued at all, that patentees have no rights at common law, the statute limiting the life of a patent to seventeen years, and that to grant such an injunction would be in effect to give the patent more than its statutory life, by the length of time intervening between the granting of the injunction and the granting of the patent, which might be some months.

We confess that it is with some surprise we learn that inventors have no rights at common law, but if they have none other than those distinctly conferred by the statute, then the points of the decision seem to be well taken; in other words, to be in accordance with common sense.

But though the law gives no protection to an inventor using the words "Patent applied for," there is, as a matter of fact, considerable protection in them, and they will undoubtedly continue to be used in many cases, and, we think, properly so. This protection arises from mechanical and business conditions, with which law has little or nothing to do. Decisions by the Patent Office upon applications are often delayed through no fault of the applicant for many months—and in some cases years—and during this time the conditions may be such that it is of vital importance to the inventor that he should manufacture his device and place it upon the market. Having done so, and by the familiar legend given notice to all concerned that he has made application for a patent—a thing which he has the undoubted right to do—it will remain for those who wish to make use of his device to ascertain as nearly as possible two things—First: Is the patent likely to be granted, and if so, after how long a time? Second: Will it pay to go into the manufacture of the device for the sake of the amount of business which can probably be done with it prior to the granting of the patent, after which, of course, there would be infringement?

The probable answer to the first question would have to be found by an examination of the records of the Patent Office, and of patent law, the examination to be made, of course, by some one sufficiently familiar with such matters to make his decision reasonably certain of being correct. The answer to the second question will depend entirely upon mechanical and business considerations. If a considerable length of time is likely to elapse before the granting of the patent, and the device is of such a nature that it can be made and quickly placed upon the market without any great outlay for drawings, patterns, special tools and machinery in preparation for its manufacture, and at little cost for advertising and other items of expense usually incident to the building up of trade in a new article, then the words "Patent applied for" will afford no protection; but if, on the other hand, it be ascertained that the patent is likely to issue in a short time, or that the necessary expense involved before the device can be placed upon the market would be so considerable as to be unlikely to be recovered before operations would have to cease by reason of the granting of the patent, then the legend will afford full protection to the inventor, and will in effect prolong the life of the patent, notwithstanding that no force is given it by law.

It will, of course, devolve upon the inventor to examine this same ground, and to decide whether or not it is best for him to make his invention public, thereby giving others the opportunity to use it, for the sake of the business which he may do with it in the interval between the date of the application and the probable issuance of the patent.

For the fraudulent use of the words "Patent applied for," the courts would probably impose a penalty, since it would manifestly be a wrong for one to use them to secure to himself the exclusive use of a thing for which no patent had been asked. But where they are honestly used, we think they will continue to serve a good purpose, both to inventors and to the public, and it is certainly preferable, in the interest of all concerned, that they should be used, than that articles upon which patent applications had been filed should be placed upon the market without anything to indicate that fact; for in the latter case persons might prepare for manufacture under the impression that the article was, and was to remain public property, whereas the words "Patent applied for," placed upon each article, would enable all parties concerned to proceed with their eyes open, upon recognized business principles and in conformity to law.

Productive Efficiency of Shops.

Time was when but little attention was paid to the construction of machine shops, except to get about so much ground covered, with a vague idea that the tools would find their places somehow. The outcome of this may be seen in the peculiar quality of unhandiness pertaining to many shops in this country. There is a vague understanding that unhandy shops are in some degree a hindrance to production; but just to what extent this is true is something that but little is known about, hence the following instance—which we have on undoubted authority—is of peculiar significance: A firm employing about 350 men recently built new shops—machine shop, boiler shop and foundry—and moved the tools from the old shops into the new ones. No new tools were added, but there was a better arrangement of the tools, and overhead cranes were put in the new shops. The general arrangement was such as called for less handling of material, and also such that the necessary handling could be done more expeditiously. The result was an increase in productive efficiency, of twenty-five per cent.! This represents a large saving, and goes to show that the loss in shops not properly constructed for the work to be done is greater than it is generally believed to be.

The whole question of shop construction is one that could profitably be studied much more than it is. It is better not to build the new shop so soon, by a year or two, than to build it in a way it ought not to be built.

A great deal more attention is given now-a-days than formerly to what a well-known engineer calls "Shopitecture," but the subject does not yet, in the majority of instances, receive the attention it deserves. There are many things to be considered, and some of them are likely to be slighted. It pays to put a good deal of thought into the construction of what is likely to vex or please the builder for the remainder of his life. If all shops were about equally unhandy, it would not matter much in the question of competition, but when one's neighbor has a good deal the advantage in this respect, it matters very materially.

Report of the Iron and Steel Association.

The Annual Statistical Report of the American Iron and Steel Association, which has just been issued by the general manager, James M. Swank, contains much that is of interest regarding the iron and steel industries of the past year. It is published earlier than usual, and enters quite fully into the details relating to the production of iron and steel during 1888. The production of pig-iron during the year was the largest in the history of the country, being 7,268,507 net tons—an increase of 81,301 tons over the production of 1887. The only country producing more pig-iron last year was Great Britain, while in consumption of pig-iron we head the list, for while Great Britain exports large amounts, we export practically none, but import some which is used chiefly for mixing with American irons. There was a very large falling off in the production of steel rails, which of course is accounted for by the fact that 1887 was a year of phenomenal railroad construction.

The increasing use of steel for structural purposes is shown by the fact that the production of iron bars and shapes fell off slightly, while that of steel bars and shapes increased considerably. The production of iron cut nails also decreased, while that of steel cut nails increased.

The statement is made that "We have annually, for several years, consumed more iron and steel than any of the great European countries. The *per capita* consumption of iron and steel by the United States is also greater than that of any other country. In 1887 our consumption of finished iron and steel exceeded 300 pounds *per capita*, estimating our population for that year at 60,000,000. In 1888, however, our *per capita* consumption declined to probably 285 pounds."

Information is given regarding the iron trade of foreign countries, our new navy, and upon various other subjects of interest.

Questions and Answers

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(202) Engineer, Chicopee Falls, Mass., asks: Will an 18-inch belt from a 30-inch to a 60-inch pulley the 30-inch pulley being the driver, and running at 320 revolutions—transmit 75 horse-power? *A.*—Under favorable conditions, yes.

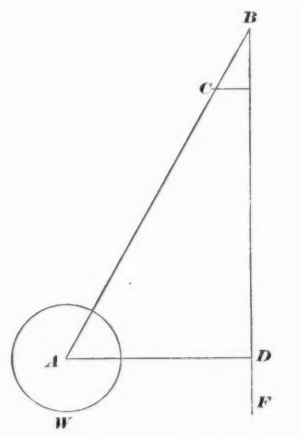
(203) A. H., Montreal, Canada, writes: In your answer to Question 159, I see you give the horse-power of an engine with cylinder 6 inches diameter, 9 inches stroke, steam pressure 60 pounds, number of revolutions 150, as six I. H. P. My calculations (which I have enclosed) give me 11 15-33 horse-power. Will you please show me where I am wrong? *A.*—The 60 pounds pressure we understand to be boiler pressure; you have assumed it to be mean pressure. Our practice in rating the power of an engine is to take only one-half of the boiler pressure for the mean pressure in the cylinder.

(204) Reader, ——, asks: Kindly give me the measurements of a ¾ and a 1 horse-power high-speed engine. Also the measurements of 1 horse and 1¼ horse horizontal boiler. *A.*—For a ¾ horse-power engine you will need a cylinder 2x5 inches; for a 1 horse power engine you will need a cylinder 2½x5 inches. Boiler pressure for both, about 60 pounds per square inch; and both engines to make about 300 revolutions per minute. If a higher speed or higher boiler pressure is desirable, then the cylinders must be made smaller. The sizes of boilers are not graduated to so fine a degree. You will need for each engine a boiler with about 1 square foot of grate surface, and about 30 square feet of heating surface.

(205) J. M. R., Trenton, N. J., asks: Is there any chemical or compound I can use that will restore carbon in steel that has been burned? For instance, if in tempering a drill, or anything of that sort, I happen to get the point too hot, is there anything that will restore the carbon and make the tool fit for use? *A.*—Steel is not necessarily deprived of carbon when it is burnt. But by burning, the grain of the steel is opened, and it is oxidized. There is no way of restoring it so that it will be equal to what it was before burning; but, by heating it to a low red heat, and continuing that heat for from 15 to 30 minutes, and letting it cool slowly, it will be much improved, or "restored" so far as is possible. We do not think there is any chemical or compound which is of the slightest help in doing this. 2. Is there any chemical that will stick two pieces of brass together? *A.*—Not that we are aware of. 3. I would also like to ask the correspondents of your paper to say something about the best forms of taps, dies and reamers for brass. I can't seem to get a reamer that won't squeal after using it a while.

(206) "Subscriber," Brattleboro, Vt., writes: Will you please give the method of obtaining the width of flat and depth of thread in the Sellers system; also the process if the threads were divided into ten parts instead of eight? *A.*—The width of the flat in the Sellers or U. S. system is always one-eighth of the pitch of the thread. There are many tables published giving the size of the bolts at the bottom of the thread, from which it is of course easy to derive the depth of the thread. In the absence of these it can be found by dividing .65 by the number of threads per inch. If the threads were flatted to one-tenth of their depth, instead of one-eighth, the flat portions would be one-tenth of the pitch in width. A sharp V thread is, in section, an equilateral triangle, each side of which equals the pitch of the thread. The perpendicular height of such a triangle is equal to the side multiplied by .86603. Hence, you can find the depth of thread when flatted one-tenth of the depth by multiplying the pitch by .866 and taking four-fifths of the product.

(207) W. H. B., Blackstone, Mass., writes: In Question 153 there must be some misunderstanding. The point in view is: Will 15-pound balls on a governor run further out from the upright spindle than 10-pound balls, both running at 35 revolutions? *A.*—Let *A C* represent the center line of one of the governor arms; *B F*, the center line of the upright spindle; and *W*, the ball. Now assume that through the center *A* a horizontal line *A D* is drawn, meeting *B F* in the point *D*; also assume that the center line *A C* is prolonged to meet *B F* in the point *B*. Now, the distance from *B* to *D* is called the height of the governor. The height *B D* of a governor of this kind depends absolutely upon its angular velocity; it does not depend on the weight of the balls. Hence, for any given speed the height *B D* remains the same, no matter whether



we use heavy or light balls. For any other speed the height *B D* will vary inversely as the square of the velocity. Therefore if we increase the speed we will decrease the height *B D*; and if the length of the arm *A B* is not changed the ball *W* will fly out further. If, under these conditions, we wish to keep *A D* the same as before, we must shorten the arm *A B*. From the foregoing it will easily be seen that at 35 revolutions the distance *A D* will remain the same when either 15 pound balls or 10-pound balls are used, provided the distance from the center *A* of the ball to the point *B* remains the same in both cases. Here, of course, the small amount of increase in friction due to an increase of weight of balls is not taken into consideration.

(208) J. B. W., New York, asks: 1. Will a governor on a direct-acting engine revolve to the right, and on an indirect-acting engine revolve to the left? I have been told by chief engineers that it makes no difference in which direction the governor revolves. *A.*—You have been correctly informed. The direction of rotation will not change the action of any common governor. Sometimes, on account of given connections between the governor and the throttle, or the cut-off valve, it may be desirable to have it revolve in a certain direction; and for other connections it may be desirable to have it revolve in an opposite direction. 2. I wish to become a licensed engineer. Can I buy a license? Or, have I to study the safety valve problem? And, after I have mastered this problem, can I then obtain a license? *A.*—You cannot buy a license. To obtain such you must pass an examination; and, to be successful, you must know considerably more than the solutions of problems relating to safety valves. You must possess a fair knowledge of arithmetic, which you can obtain by studying any elementary work on the subject. Besides this, you must have a fair knowledge of the steam engine and boiler, which you may obtain from books; and, in addition to these, you must have a practical knowledge of running an engine. Judging from your letter we should say that, if you devote your spare time during two years to hard study, you may be competent to pass an examination. 3. Why do hot air engines revolve only in one direction? *A.*—Hot air engines, like steam engines, which have no reversing gear, can only revolve in one direction, and this depends on the relative position of the crank and eccentric.

(209) E. D. G., Philadelphia, Pa, writes: In the article on "Epicyclic Trains," AMERICAN MACHINIST, Feb. 14, Prof. A. T. Woods says by adjusting the speed of the first wheel we can get a ratio of 641 to 1, etc. Will you give me the formula? *A.*—Prof. Woods replies to this query as follows: The general formulas which cover the various combinations which can be made with epicyclic trains are too complicated to be clearly explained without taking more space than their practical importance warrants. They are discussed at length in Willis' "Principles of Mechanism." Copies of this book—now out of print—can doubtless be found in libraries, such as that of the University of Pennsylvania. Many problems, such as the one mentioned in the article referred to, can be solved as follows: The general formula there given is, $v = \frac{l-a}{f-a}$ (see AMERICAN MACHINIST, Feb. 14, 1889). If the last wheel *L* is to make 641 revolutions while the arm makes 1, the formula becomes $v = \frac{641-1}{f-1} = \frac{640}{f-1}$. It now remains to select some value for *f*, which will give satisfactory results, and this value can best be determined by trial. We will assume $f = 33$, then $v = \frac{640}{33-1} = \frac{640}{32} = 20$, and any numbers for teeth can be selected which will give this ratio. For instance, $20 = \frac{75 \times 60}{15 \times 15}$, which would be good numbers for the gears. Further, as we have $f = 33$, and $a = 1$, we must connect the first wheel and arm with the driving shaft, so that their speeds will have the ratio $\frac{f}{a} = \frac{33}{1}$. This can be accomplished by four wheels having 99, 15, 75, and 15 teeth. To obtain this ratio of 641, then, connect the first wheel *F* of the epicyclic train by ordinary gearing on fixed centers to the "arm," so that *F* will make 33 revolutions while the arm makes one, and in the same direction. Then in Fig. 5 of the article referred to, the numbers of teeth for the gears of the epicyclic train will be $F = 75$, $C = 15$, $D = 60$, and $L = 15$.

(210) Inquirer, Toledo, O., writes: Please give rule for finding the amount of water required per hour to condense the steam in a compound engine? High-pressure cylinder, 30 inches diameter; low-pressure cylinder, 52 inches diameter; stroke, 36 inches. *A.*—The amount of injection water depends on the temperature of the steam after it has done its work, the temperature of the cooling water, and the temperature after condensation, or that of the hot well. Let T_1 be the temperature of the discharged steam; T_0 the temperature of the cooling water; and Q_1 its quantity in pounds; and T_2 the temperature after condensation. To find the quantity Q of the injection or cooling water, we have the following rule:

$$Q = \frac{1{,}114^\circ + (0.3 \times T_1) - T_2}{T_2 - T_0}$$

The above rule reads thus: To 1,114 degrees at the temperature of the discharged steam multiplied by 0.3; from this sum subtract the temperature after condensation, and divide the remainder by the temperature after condensation, less the temperature of the cooling water; the quotient will be the required quantity of the injection water. To apply this rule to your case, we must know the pressure of the steam when the exhaust is about to open; when this pressure is known we can easily find the temperature T_1 of the discharged steam by referring to the tables generally given in books treating on engineering; we must also know the temperature of the injection water. Hence your example may be reduced to the following: To find the amount of injection water required for an engine, the steam at exhaust having a pressure of 10 pounds absolute, the temperature of the injection water 60 degrees, temperature of the hot well 120 degrees. Now the temperature of steam at a pressure of 10 pounds absolute is 193 degrees; hence we have

$$Q = \frac{1{,}114^\circ + (0.3 \times 193) - 120}{120^\circ - 60^\circ} = 17.53 \text{ pounds.}$$

That is, the amount of injection water is 17.53 times the weight of steam for this particular example. Since the temperature of the injection water may be very variable, caused by the condition of weather, and since the cut-off may also vary, the following simple rule may give results sufficient for general practical purposes, and that is, allow for a quantity of injection water which is 30 times heavier than the steam used.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.
Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.
$100 Reward, page 14.
$100 Reward, page 14.
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Shafting Straighteners. J. H. Wells, Tampa, Fla.
Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.
Duplex Gear Cutters. R. M. Clough, Meriden, Ct.
20" Upright Drills. J. E. Snyder, Worcester, Mass.
23" Upright Drills. J. E. Snyder, Worcester, Mass.
25" Upright Drills. J. E. Snyder, Worcester, Mass.
28" Upright Drills. J. E. Snyder, Worcester, Mass.
"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.
The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.
R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.
Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.
Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.
Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.
Fire Brick and Clay Retorts; large variety; special shapes to order. Borgner & O'Brien, Philadelphia.
Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.
Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.
Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.
Iron Planers from 16" to 36" wide by any length. H. C. Pease & Co., Worcester, Mass.
Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.
For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.
All sizes of Taps & Dies from 5-64 of an inch to 4 inches V, U. S. S., Whitworth, Square & Left-Hand Threads. M'f'd by S. W. Card & Co., Mansfield, Mass.
Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illustrated. Frasse & Co., 92 Park Row, New York.
Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.
See Illustration of Portable Key-Seating Machine in April 4 issue. For further particulars address T. C. Dill Mach. Co., 726 Girard av., Philadelphia, Pa.
Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.
Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.
W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.
Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.
Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.
Patterson, Jordan & Gottfried, 146-150 Centre st., N. Y. Metals, Machinery, Hardware, Tools and Supplies for Machinists, Mills, Engineers, Brass Goods Mfrs., Factories, etc. An extensive assortment of Bolts, Screws, Wire, Taps, Drills, etc., carried in stock.
Patent or shop rights for sale, for perforating iron or steel plates for steam boilers, bridge work, iron or steel ship work, marine boiler heads, equal to drilled work and fifteen times quicker. Samples can be seen and circulars obtained from R. E. Dietz, 60 Laight St., New York.
The International Boiler Co., Limited (Allan Stirling, M. E., president,) manufacture the safest, most economical, compact and durable water tube boilers. All wrought metal. Large mud drum. Perfect circulation. By unscrewing only three bolts, access is gained to every part of the boiler. Dry steam and great economy of fuel guaranteed. Office, 74 Cortlandt street, New York.
"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.
"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.
"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 25, 1889 issue, 75 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.
"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 89 articles have thus far appeared up to and including the April 18, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

The Dalton (Ga.) Gas Company will build works.

S. P. Malone expects to build boiler shops at Memphis, Tenn.

John Romelle proposes to build a machine shop at Atlanta, Ga.

Shelly & Wood are building a large shoe factory at Gainesville, Ga.

The Staley Mills Company will build a cotton mill at Jonesboro, N. C.

The Southern Car Works, Knoxville, Tenn., contemplate enlargement.

The Galvin Brass Company, Detroit, Mich., is building a new foundry.

The Southern Pacific Railroad Co. expect to enlarge their shops at Houston, Tex.

H. Wellman is interested in building a saw-mill and planing-mill at Cattlesburg, Ky.

W. D. Heape is interested in a company that will build a furniture factory at Florence, S. C.

The capital stock of the Ajax Forge Company, Chicago, Ill., was recently increased $150,000.

The Baton Rouge Electric Light and Power Company has been organized at Baton Rouge, La.

The town of Bristol, R. I., is offering special inducements to manufacturers to locate there.

The Mayfield Woolen Company has been incorporated at Mayfield, Ky. Capital stock, $100,000.

The Electric Light Co., Decatur, Ala., has bought out conflicting interests, and will build a new plant.

The Petroline Fuel Company will locate a factory at Duluth, Minn., for the manufacture of fuel from sawdust and coaldust.

A stock company, known as the South Boston Woolen Company, has been formed, to build a mill at South Boston, Mass.

A. Reynolds & Son, Macon, Ga., will rebuild the part of their machine shop recently burned, and will otherwise enlarge the works.

Sampson Steam Forge Company, Chicago, Ill., capital $100,000, for general forging, has been incorporated by S. R. Wilson, F. J. Smith, J. W. White and F. J. Wilson.

The Columbus River Lumber and Cordwood Company will build a mill in the vicinity of Portland, Ore., with a daily capacity of 50,000 feet of lumber and 100 cords of wood.

H. C. Bennett, Bridgewater, N. C., will at once begin the rebuilding of his cotton factory, which was burned down at that place some time ago. The capacity of the factory will be increased.

The Stella Grate Manufacturing Co. has been chartered, at Chattanooga, Tenn., by J. B. Dowden, W. J. Selman, G. N. Henson and others, for the manufacture and sale of grates, stoves, castings, etc.

The Brown & Sharpe Manufacturing Co., Providence, R. I., have issued another edition of their general catalogue, under date of April, 1889. This catalogue ought to have a place in every mechanic's tool chest.

The Williams Engine Works, Beloit, Wis., are having built, at the works of E. P. Allis, Milwaukee, Wis., a Shaw electric traveling crane, to be tested with a load of 22½ tons. One of these cranes is in use in the Allis foundry.

The Turner Brass Works, for the manufacture of specialties in brass, German silver and iron, and for plating and the manufacture of castings, has been incorporated in Chicago, Ill., by E. S. Turner, C. McNellis and W. D. Washburn.

The Pulaski (Tenn.) Foundry Manufacturing Co. has been chartered, with Geo. W. Palmer, of Saltville, president; N. L. Look, Marion, vice-president; and L. S. Colfee, secretary, for the manufacture of machinery, the building and operating of waterworks and electric light plant.

The Gilkerson Machine Company have again come into possession of the works (which had been leased) at Homer, N. Y. They write us that they are busy on planer, planer vises, and special carriage machinery, and that they expect to bring out a complete line of carriage making machinery.

The Sperry Electric Mining Machine Company, Chicago, Ill., has been incorporated, with a capital stock of $100,000. Incorporators: A. L. Sweet, Elmer A. Sperry and Francis W. Parker. The company will manufacture electric coal cutters, electric mining drills, and other electrical machinery for mining purposes.

There is water-works agitation at Elberton, Ga.; Fort Valley, Ga.; Gainesville, Ga.; Mount Sterling, Ky.; Richmond, Ky.; Llano, Tex.; Luling, Tex.; Abingdon, Va.; Warrenton, Va.; South Framingham, Mass.; Dowagiac, Mich.; South Pueblo, Colo.; Jamestown, N. Y.; Florence, S. C.; Mattapan, Mass.; Milton, Mass.; Andover, Mass.; Denver, Colo.

The William G. Fisher Manufacturing Company, of Cincinnati, with a capital of $150,000, employing from 300 to 500 hands, and a daily pay-roll of from $500 to $700 per day, is about to move to Kokomo, Ind. They manufacture wrought-steel ranges, artificial gas machines, natural gas stoves, wrought-steel office and family safes, and cooking and heating apparatus.

Nearly one hundred of the leading citizens of Exeter, N. H., have united in forming a Board of Trade for that town. Hon. John J. Bell was elected president, and a strong executive committee, as well as one on new industries, was appointed. It is the purpose of the people of Exeter, through this board, to make the commercial advantages of their town more widely known, and to extend substantial encouragement to such desirable manufacturing industries as may locate among them.

The Kitson Machine Company, Lowell, Mass., has bought out the firm of Jas. Butterworth & Son, of Philadelphia. The purchase includes all patterns pertaining to their well known rag pickers, rag dusters, etc., together with all their special tools, jigs and templates for building these machines. A portion of the works will be devoted exclusively to the building of the Butterworth machinery, and a large stock of repairs will be carried both for old and new style machines. By this purchase the two largest establishments in the line of shoddy picker work are brought under one control.

We have received from J. W. Holmes, C. E., of Batavia, N. Y., his illustrated catalogue of engineering and surveying instruments. Although his productions are, of course, primarily intended for use by surveyors and civil engineers, they are especially well adapted to use about manufacturing establishments, by reason of their accuracy of construction and special features. This is especially true of what is called the Solar Theodolite, which, to our knowledge, has been used in laying out manufacturing establishments, locating and aligning shafting, engines, etc., with particularly gratifying results.

Machinists' Supplies and Iron.

NEW YORK, May 4, 1889.

Iron—American Pig.—The volume of trade has been curtailed during the week by the holidays, and the condition of the market generally is unsatisfactory to iron men. Southern brands have been sold at low prices comparatively, and it seems likely that a general reduction is not far off. We quote No. 1 X Foundry, $17 to $18; No. 2, $16 to $17; Grey Forge, $15 to $15.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mechanical draftsman wants situation. Box 93, AMERICAN MACHINIST.

Wanted—Situation by mechanical draftsman. New York or vicinity preferred. Box 95, AM. MACH.

Wanted—Situation as foundry foreman; large experience. Good reference. Box 97, AM. MACHINIST.

A mechanical draftsman with practical shop experience wants position. Box 92, AMERICAN MACHINIST.

Wanted—A position as mech. draftsman; good practical exp., marine or stationary. C., AM. MACH.

Wanted—A first-class lathe hand with $1,000. A good salary will be paid to a first-class man. Address Box 90, AMERICAN MACHINIST.

Wanted—By a man of experience, a position as supt. or chief draftsman in locomotive or stationary engine shop. Address M. E., AM. MACHINIST.

Wanted—A man to temper dies, taps and reamers. Must be competent and understand the best methods of tempering steel. Address Box 94, AMERICAN MACHINIST.

Wanted—Salesman, to sell a boiler feed-water purifier and heater. Reference required as to ability and experience as salesman. Address H. M. C., AMERICAN MACHINIST.

Wanted—A first-class moulder, competent to superintend a foundry. Must have $5,000; a good salary will be paid to a first class man. Address Box 78, AMERICAN MACHINIST.

Wanted—Experienced foreman for a machine shop, working about fifteen machinists on new and repair work. State age, experience, references, and wages expected. "Maryland," AM. MACHINIST.

Mechanical engineer desires position as designer, draftsman or superintendent; experienced all-around man; familiar with shop and pattern work. Chicago preferred. Address Box 96, AM. MACH.

Wanted—A first-class machinist with $5,000 to $10,000 cash in an old and well-established manufacturing business. Address P. O. Box 104, Baltimore, Md., giving reference, age and experience.

A practical machine, tool and gauge maker of large experience in charge of designing and making especial machinery, fixtures, jigs, etc., desires a situation after June 1. Address Geo. Everett, Canton, Mass.

Optician—Wanted as foreman in our optical factory, a man who thoroughly understands the manufacture of spectacles, glass and focus grinding, etc. Queen & Co., 924 Chestnut street, Philadelphia, Pa.

Wanted—Superintendent to take charge of a wood-working machinery manufactory; must be versed in designing, pattern making, and understand the handling of men. Address Indiana Machine Works, Fort Wayne, Ind.

Wanted—Foreman for steam pump works. Must have experience in handling men, and in the best methods of getting out "Duplex" pumps; state age, experience, and salary expected. Address "Ohio," AMERICAN MACHINIST.

Wanted—Two or three energetic young machinists of three or four years' experience, who desire an excellent opportunity to improve their position, and who care more for advancement, and are willing to work for it, than money. The Straight Line Engine Co., Syracuse, N. Y.

Machinist with good technical education, 13 years' exp. in building tools, pumps, marine, stationary and locomotive engines, in charge of machine department at one of the largest iron furnaces South; wants situation, energetic, best references. A. J. S., 344 W. 14th street, New York.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Gerlach's Engineers' specialties beat the world. Send for price list. Crescent Mfg. Co., Cleveland, O.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Steel Name Stamps, Copper Burning Brands, etc. W. G. Sackmann, 1099 First av., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Wanted—Financial aid to develop a valuable invention in shingle machines, in which I could give an interest. Correspondence solicited. Mac, AM. MACH.

For sale, cheap, 32-inch Prentice Bros. Back-Geared Power Feed Drill Press, new. Price, $250. Address Standard M'f'g Co., Moore's Hill, Ind.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Machine wanted for upsetting or compressing by hydraulic or other means, bars of iron or steel for eye-bars, having a sectional area of 3 to 10 square inches. Address "M. G.," care P. Everitt, 293 Broadway, New York.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Established 1832.

BRADLEY'S HELVE HAMMER.

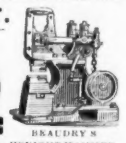
BRADLEY'S POWER HAMMERS

The BEST in the WORLD

RUN BY BELT.

BRADLEY'S UPRIGHT HAMMER.

Over 1500 in USE



BRADLEY'S UPRIGHT HAMMER.

BRADLEY'S HEATING FORGES

BRADLEY'S HARD COAL HEATING FORGE.

Indispensable in all shops to keep BRADLEY'S CUSHIONED HAMMERS and men fully employed and reduce the cost of production.

BRADLEY'S SOFT COAL FORGE.

BRADLEY & CO. SYRACUSE, N.Y.
63 Murray st. NEW YORK; 98 Sudbury st. BOSTON, MASS.

SOLID EMERY AND Triple Coated OIL STONES KNIFE SHARPENER

WHOLESALE ONLY BY THE TANITE CO., STROUDSBURG, PA.

"Star" Foot Lathe Swings 9x25 in.

LATHE

Screw Cutting Automatic Cross Feed, etc.

Scroll Saws, Circular Saws, Lathes Mortisers.

Catalogue Free of all our Machinery.

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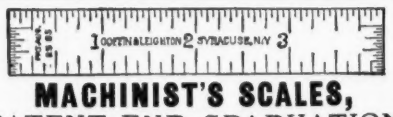

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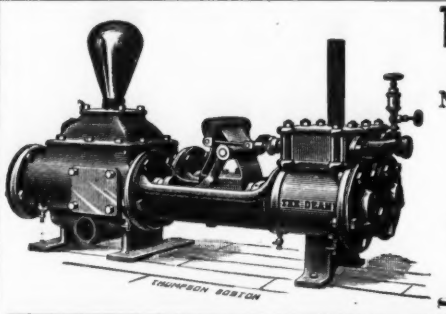

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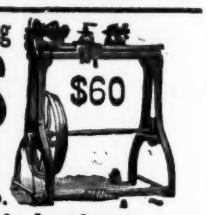

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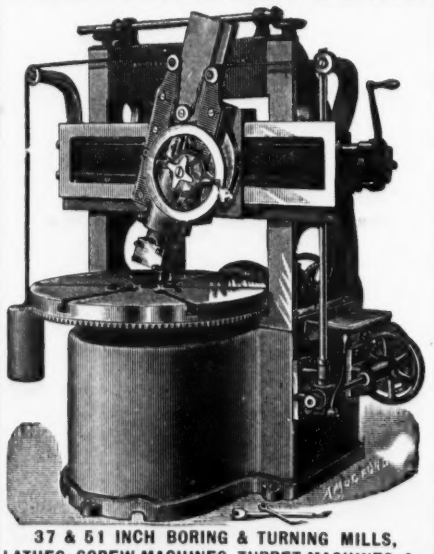

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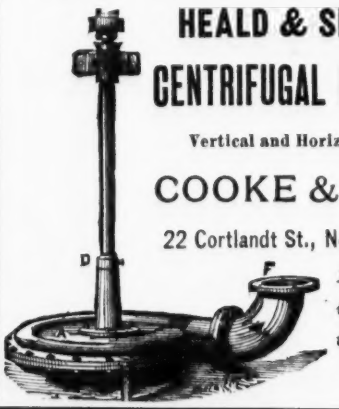

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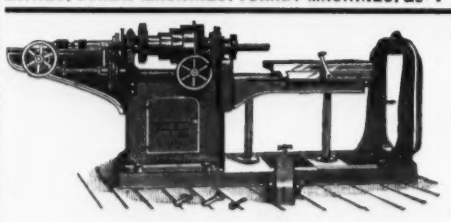

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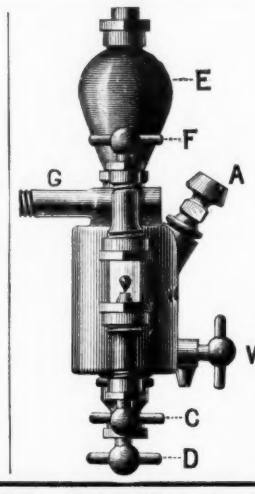

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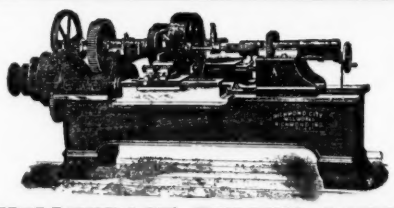

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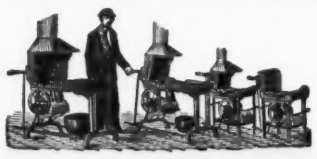

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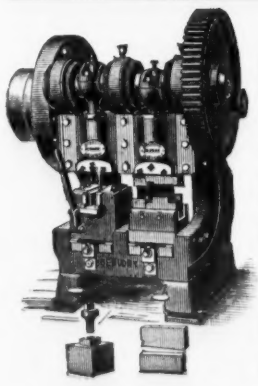

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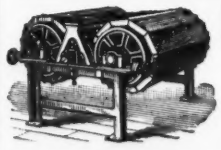

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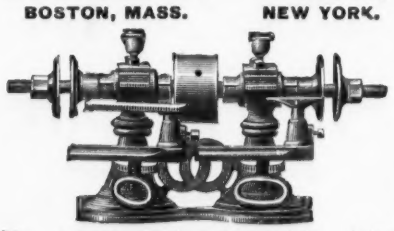

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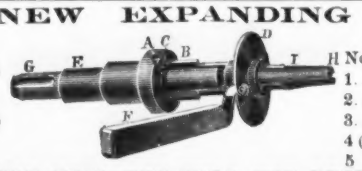

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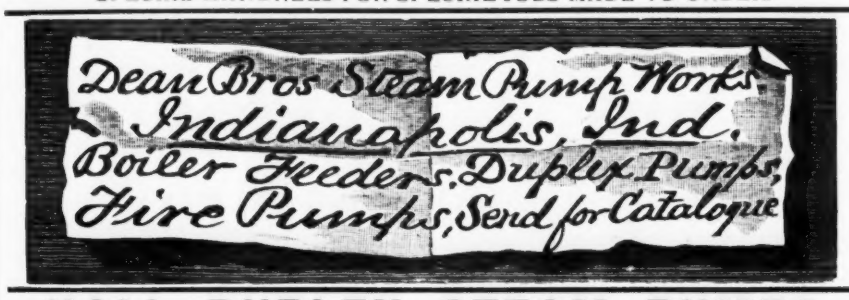

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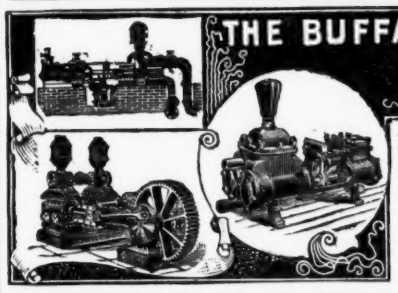

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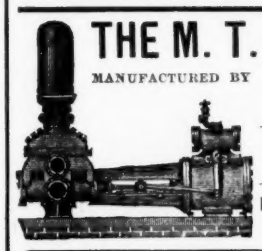

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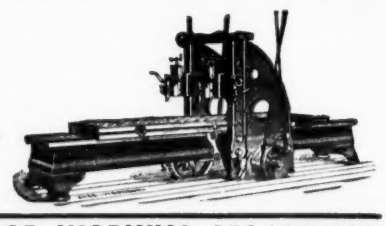

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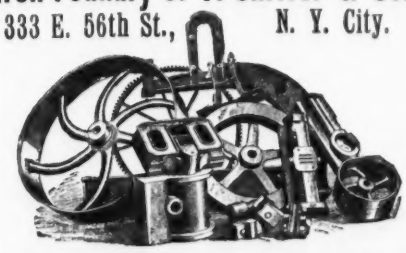

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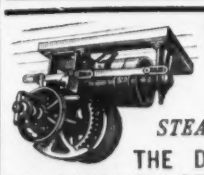

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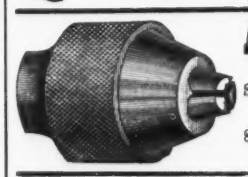

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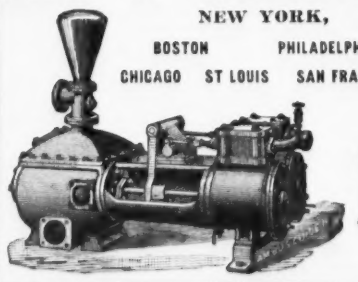

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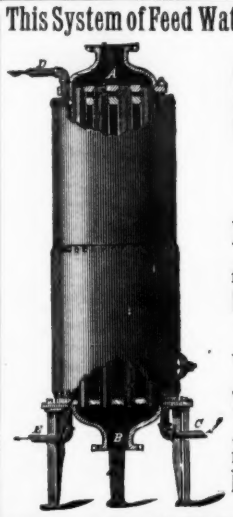

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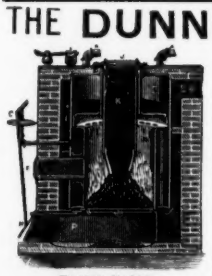

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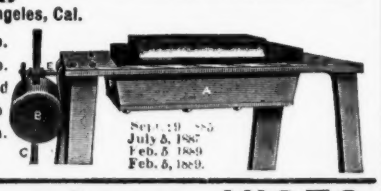

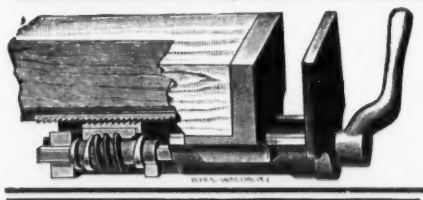

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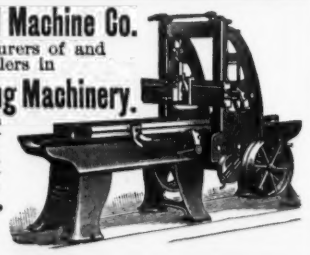

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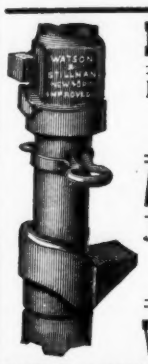
2	3½ "	0 to 1 "
2½	4 "	0 to 1 in., ex. strong.
3	6 "	0 to 1½ inch.
4	6½ "	0 to 2 "



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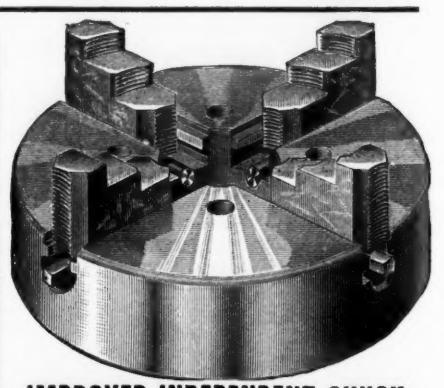

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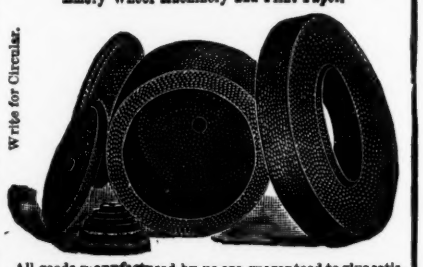

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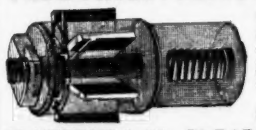

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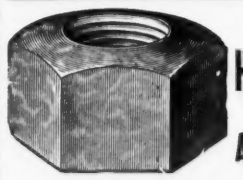

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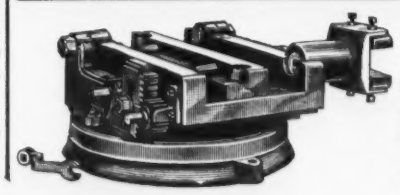

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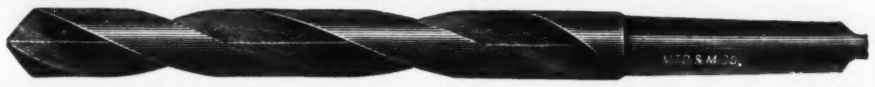

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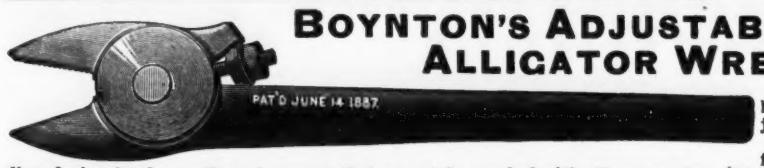

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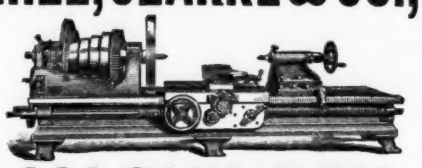

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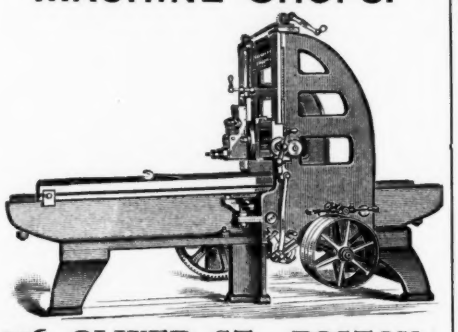

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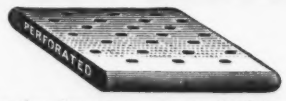

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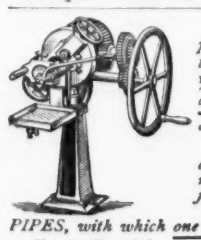

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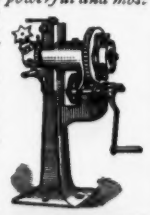

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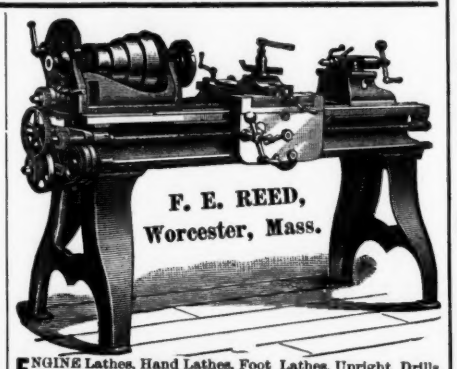

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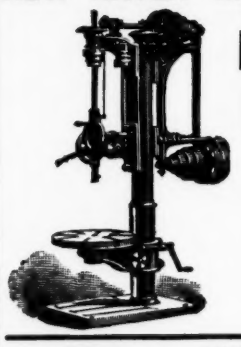

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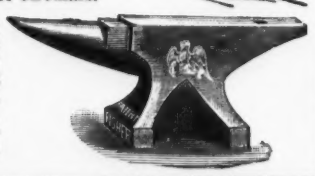

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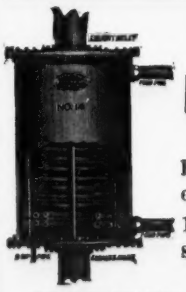

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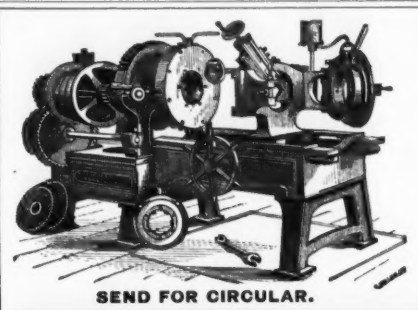

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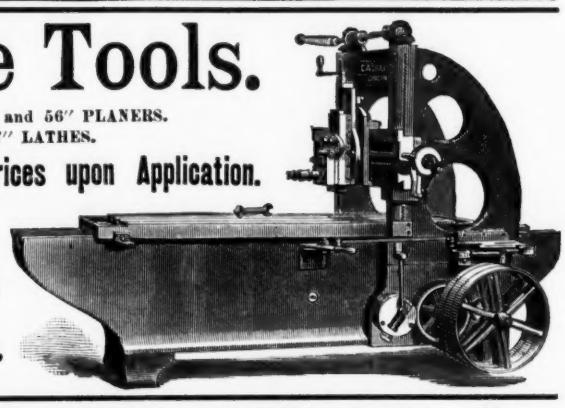

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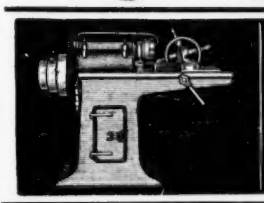

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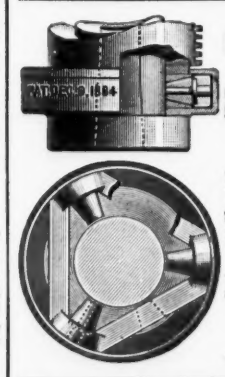

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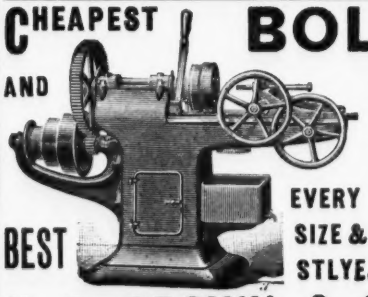

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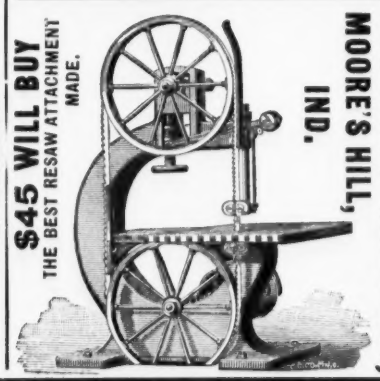

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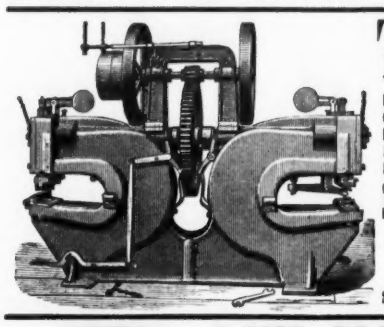

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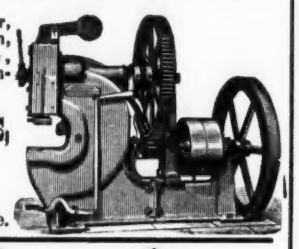

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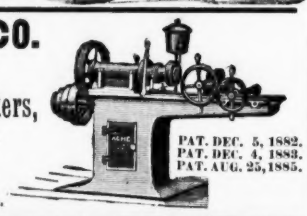

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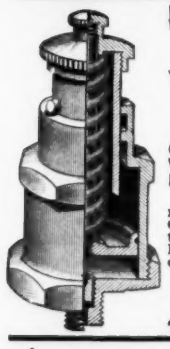

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$100 Reward.

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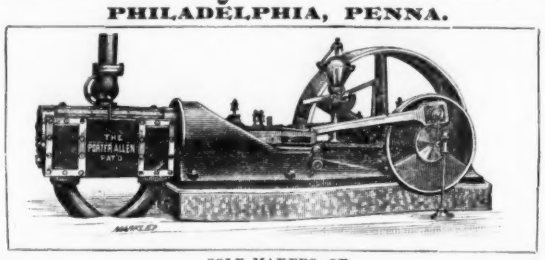

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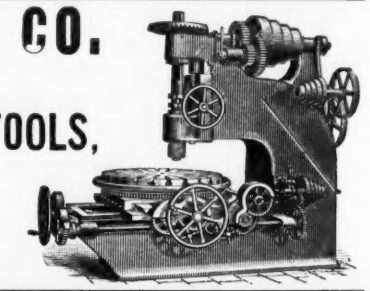

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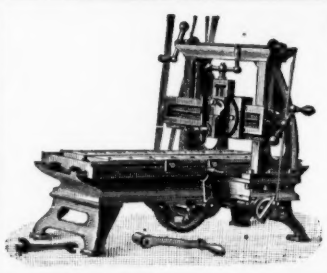

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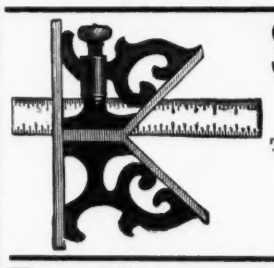

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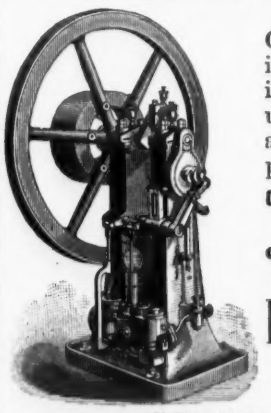

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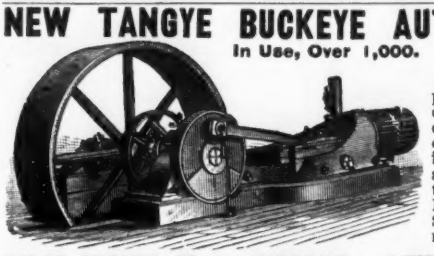

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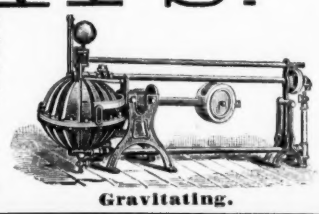

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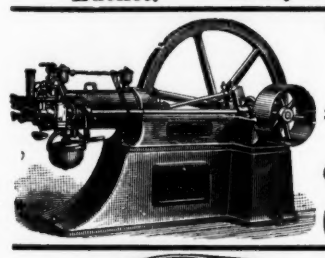

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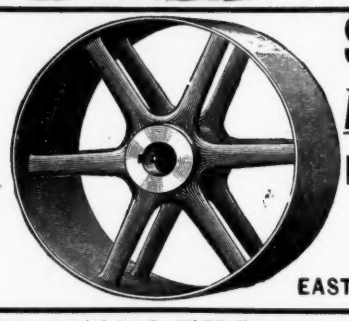

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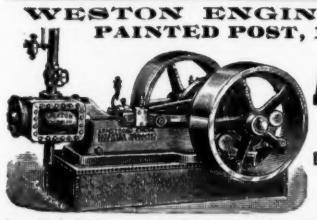

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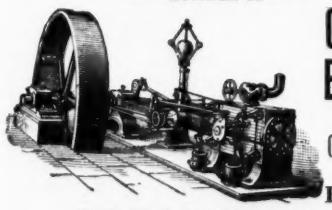

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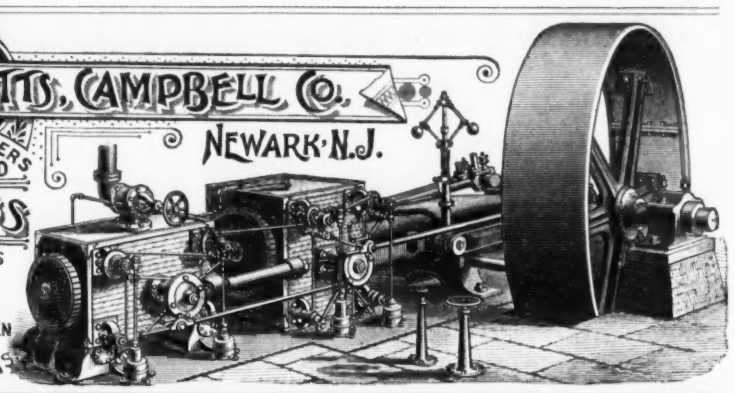

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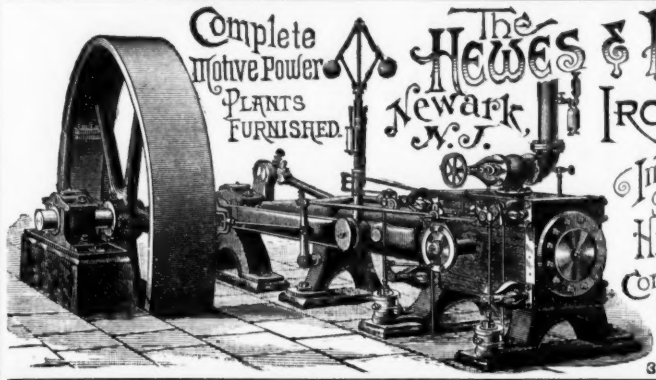

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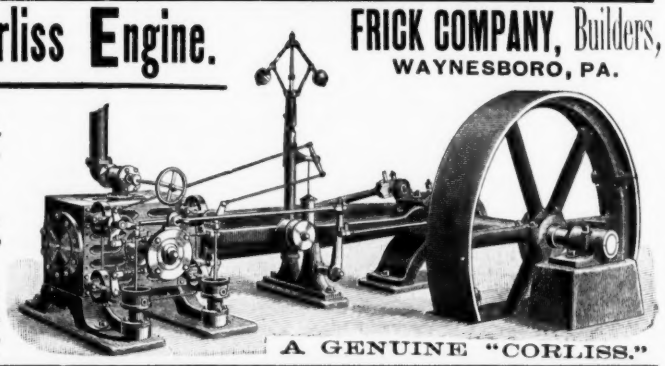

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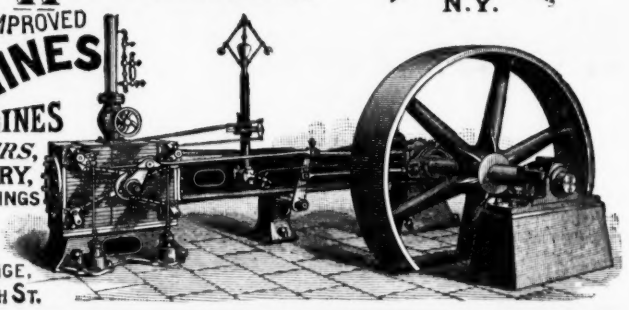

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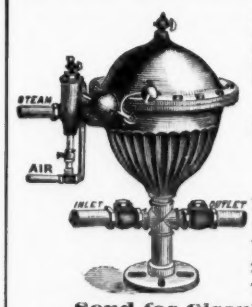

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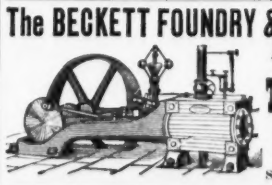

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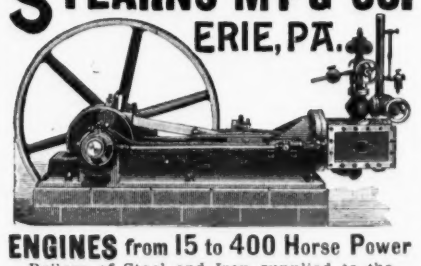

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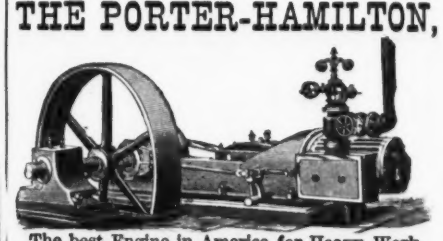

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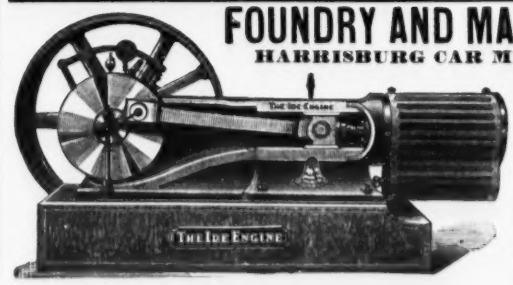

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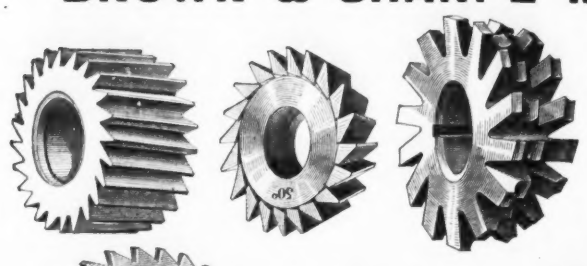

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FOR USE ON

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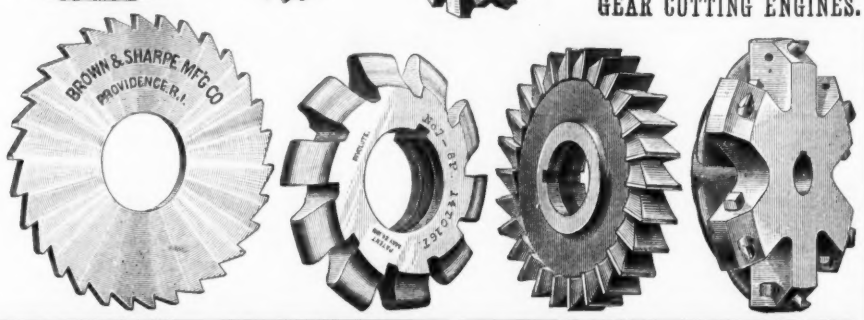

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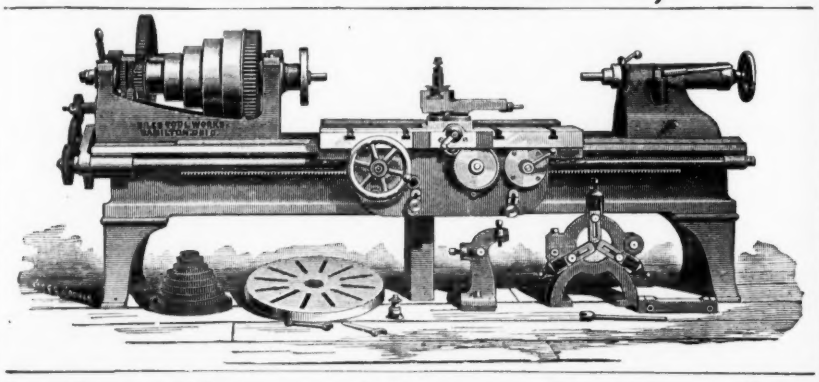

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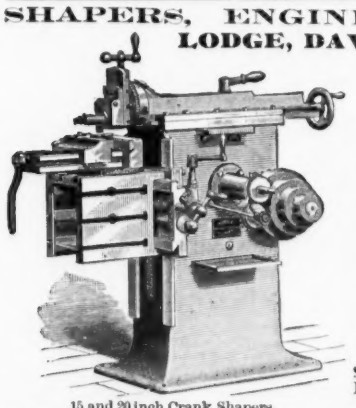

15 and 20 inch Crank Shapers.

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28, 32 and 40 inch Power Feed Drills.

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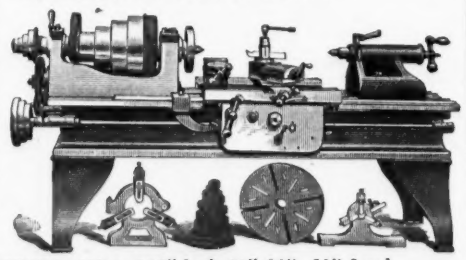

SHAPERS, 15" and 20" Crank. 20", 26", 32" Geared.
ENGINE LATHES, 17", 19", 21", 24", 27", and 38".
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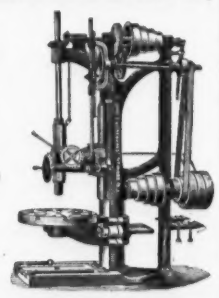

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Sizes, 18", 25", 36", 50", 60", 84".

GEAR AND RACK CUTTING TO ORDER.

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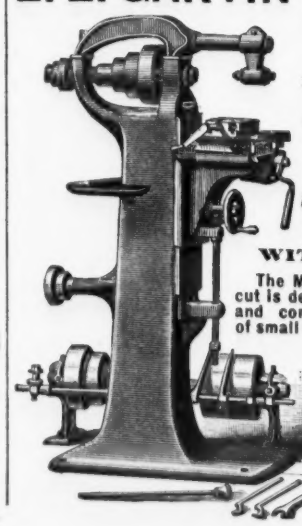

The Machine shown in cut is designed for rapid and convenient milling of small work.

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Boring Mills,

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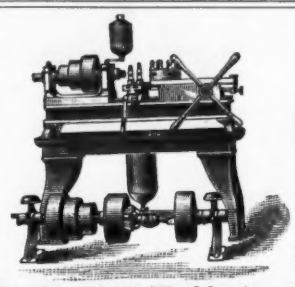

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For ⅝ in., 3 in. and smaller holes.

Revolving Head Drilling Machines.

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DROP FORGINGS

Of Every Description, of Bronze, Copper, Iron and Steel.

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MACHINE TOOLS

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SMALL TOOLS & FIXTURES.

Gear Cutting in all its Branches.

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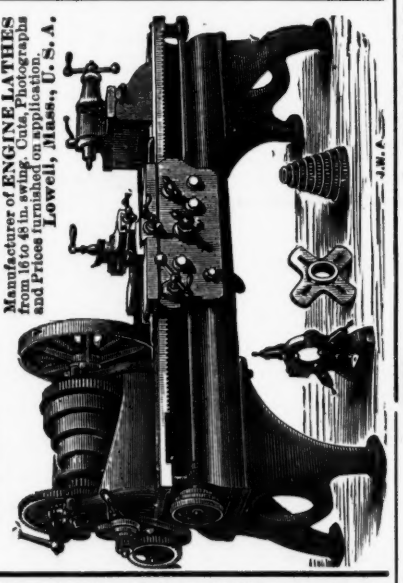

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The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500' long by 100' wide; a foundry 250' long by 90' wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

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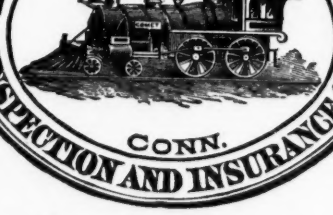

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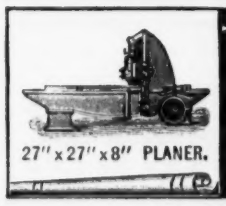

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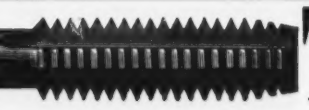

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